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# USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT



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30 December 1985

## USSR REPORT

### MACHINE TOOLS AND METALWORKING EQUIPMENT

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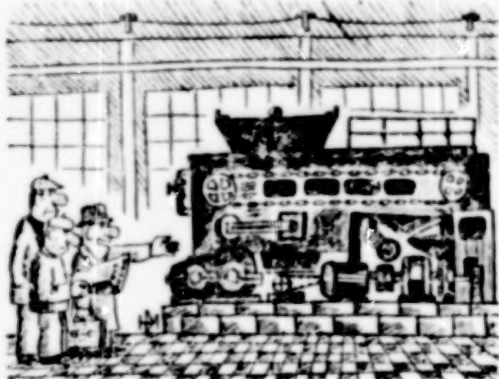
INDUSTRY PLANNING AND ECONOMICS

CARTOON SHOWS COMMON PLANT MODERNIZATION PROBLEM

Moscow EKONOMICHESKAYA GAZETA in Russian No 37, Sep 85 p 24

[Cartoon]

Reconstruction is ineffective  
in some enterprises; obsolete  
equipment is being installed.



"Get rid of this machine and  
replace it with the one we had  
last year."

/9365

CSO: 1823/013

## INDUSTRY PLANNING AND ECONOMICS

### MACHINE TOOL BUILDERS LAUDED FOR MEETING PLAN TARGETS

Moscow TRUD in Russian 6 Jul 85 p 1

[Interview with V.G. Skryabin, deputy minister for the machine-tool and tool building industry, by N. Fomina: "According to Advanced Technology"]

[Text] The deputy minister for the machine-tool and tool building industry, V.G. Skryabin, talks about how the pre-Congress competition by ten-day periods is going.

[Question] Vasiliy Georgiyevich, the third ten-day period has been completed. What have its results shown?

[Answer] The completion of the ten-day period coincided with the end of the six-month period. We are happy with the results that the industry has achieved upon arriving at this point. First of all, this pertains to the growth of labor productivity. Whereas the plan called for it to rise by 4.5 percent, it actually rose by 5.7 percent. The main factor that made possible the high growth rates in labor productivity was scientific and technical progress, as was stressed at the April (1985) plenum of the CPSU Central Committee. In the current year, we should manufacture about 14,000 machine tools with numerical program control, including 1,550 finishing centers, and over 4,000 industrial robots. The results for the six-month period and the commitments of the pre-Congress competition indicate that the industry successfully coped with these tasks. In accelerating production rates, an important role is played by the competition by ten-day periods, enthusiasm, creative heat, and the patriotic aspirations of the workers. The staff of the industry has received many reports about workers' achievements and the undertakings of advanced collectives.

[Question] Please relate some of these.

[Answer] The other day, the collective of the production association, Machine-Tool Building Plant imeni Sergo Ordzhonikidze, reported the accomplishment of five-year plan tasks relating to growth rates in the volume of production and in labor productivity. By the end of the year, the collective of the association will manufacture 15 machine tools with numerical program control above the five-year plan and will realize 1.5 million rubles' worth of production above the plan.

The Sverdlovsk tool plant. Here, at brigade councils, the following decision was adopted: to complete the monthly task one day early. Workers, aided by economists, technologists, and managers of all services compiled a chart that provides a rhythm of work for all subunits. Front-rank workers of the enterprise together with specialists thought out in the minutest detail the measures that would make possible the fulfillment of this very strenuous commitment.

During the pre-Congress competition, a large amount of attention is being given to product quality by the labor collectives of the industry, such as those of the Kiev Machine-Tool Building Production Association, the Minsk Machine-Tool Building Plant imeni S.M. Kirov, the Orsh machine-tool building plant, Krasnyy Borets, and many others.

[Question] What aid is the ministry together with the Trade Union Central Committee giving to participants in the pre-Congress watch?

[Answer] To us, the staff of the ten-day shock periods, flows all of the operational information on the progress of each of the ten-day periods. We do not allow any question to be outside our field of vision, whether it pertains to supply, interaction of joint participants, or the provision of material, raw material, or hardware resources. Together with the Trade Union Central Committee, we also regularly examine questions of organizing competition: how the results are summed up, how the winners are honored, how the experience of the advanced workers is disseminated, and what kind of engineering support there is for the commitments contemplated in the brigades. And this, of course, affects the development of creative initiative on the part of workers. Thus, at the Voronezh Production Association for the Output of Forge Press Equipment, designer B. Zinchenko, engineer-designer O. Lebedeva, and workers of the robot section with all-out effort accelerated the mastery of new methods for the assembly, adjustment, and testing of robotic technology. As a result, labor content went down by 29 percent and labor productivity in this section rose by 17 percent.

Tasks for the further development and encouragement of the ten-day period pre-Congress competition were defined in a joint resolution by the Ministry of Machine-Tool and Tool Building Industry and the Trade Union Central Committee.

9645/13046  
CSO: 1823/222

## INDUSTRY PLANNING AND ECONOMICS

### GOSPLAN OFFICIALS ON ADVANCES IN MATERIALS HANDLING TECHNOLOGY

Moscow PLANOVYE KHOZYAYSTVO in Russian No 6, Jun 85 pp 73-80

[Article by A. Shadye , deputy subdivision director of the USSR Gosplan, and P. Krylov, senior expert of the USSR Gosplan: "The Development of the Hoisting and Transportation Machine Industry"]

[Text] A modern industrial enterprise is characterized by a complex system of economic links and large heterogeneous goods flows which develop as the societal division of labor intensifies and the level of concentration, specialization and cooperation increases. The increasing volumes of production involve an ever increasing number of objects of labor in the traffic. An interruption at any stage of the traffic disturbs the rhythm and lowers the working effectiveness of the shop, enterprise, association and even the entire sector.

For long the formulation of measures to increase the volumes of production and improve the efficiency has concentrated mainly on the primary sectors. As a result, the development of the auxiliary departments has lagged behind. Such an orientation also determined the structure of the production of progressive kinds of equipment and mechanisms in which the share for auxiliary production is negligible and the technical level of many machines low. The limited means made available was the primary factor here. Another factor of no less importance was the assignment of poorly-qualified workers to the auxiliary operations.

These and other circumstances explain the fact that currently more than 13 million persons are employed in materials handling, while the yearly expenses associated with this are 20 billion rubles. Owing to the inadequate level of mechanization and automation of such processes, those employed in the basic production spend nearly one-fifth of their work time on the movement of objects of labor.

Increased production volume and intensification of specialization require a heightened managerial and technical level of the processes of handling objects of labor and a first-priority mechanization and automation of these. This stems from the need not only for timely delivery of raw materials and semi-finished stock and their uninterrupted supply to the production stations,



sectors and departments, but also for reduced losses in the objects of labor. The main point is that the auxiliary operations hold back the increase in the labor productivity and the effectiveness of the national production. That is why the problem of mechanization and automation of materials handling has become one of the most important.

The manufacture of lifting and transportation machinery has been called upon to play a special part in this matter. The degree of satisfaction of the requirements for means of mechanization and automation of the materials handling and the kinds of new progressive equipment to be used in the goods handling are the key to the solution of this economic problem.

Much has been done in recent years. In the 10th Five Year Period unique uninterrupted-batching conveyor systems for giant blast furnaces have been built and introduced at the Krivorog and Novolipetsk metallurgical combines; special conveyor belts for the transport of short-sized wood in the paper and cellulose industry; and a complex of equipment for loading and unloading of heavy-duty containers at the terminals of the MPS [Ministry of Means of Communication].

Such progressive means of automation have appeared as transportation systems based on monorails, conveyor handling robots for piece goods, equipment complexes for overhead pusher conveyors with systems for automatic control of goods, including microcomputer addressing with power amplifiers, noncontact transmitters of operative information, and elaborate communications between the objects and the addressing equipment, enabling an increase in labor productivity and a 15-20 percent reduction in the production space; rack-type stacking cranes with automatic control, including microcomputer control for long-sized sheet loads between 0.5 and 12.5 tons, which free more than 3,100 conventional workers by eliminating the profession of the strap handler. Vibrational horizontal and vertical conveyors with a trough 100-320 mm wide and pneumatic pipeline container systems enable an improvement in the sanitary conditions when transporting toxic powderlike cargo.

Since the start of the current five year period we have been developing bridge cranes with a 15-30 percent reduction in mass as compared to those already being produced. This will provide an annual savings of 10,000 T of rolled steel. Conveyor belts with a new design of roller are being built, allowing a savings of nearly 0.5 T metal on each. Twin-container dock loaders have been developed for ocean and river ports, designed to handle containers of 30 T gross weight, along with hopper-grip loaders for river ports with a productivity of up to 800 T/h. These unique machines will enhance the labor productivity by a factor of 1.5-2 and totally eliminate the heavy manual labor of longshoremen and strap handlers.

However the manufacture of the new technology in small series cannot have major influence on the level of mechanization of the work, owing to the lack of industrial capacity. In many cases mechanization handles only isolated stages of the goods flow, which results in significant expenses for manual labor at the machines and mechanisms.

For example, there are 93,000 machinists for conveyors and transporters in industry. But at the same time, 285,000 loaders, carriers and other workers labor at these machines. Even though the experience of progressive enterprises has demonstrated the high efficiency of automated and complex-mechanized materials handling centers, the percentage of these is still negligible, while the development of new ones is prevented by the lack of complete equipment units. As a result, only 3,600 out of 405,000 materials handlers work at automated and complex-mechanized centers.

The irrational employment is far from being the only characteristic of the loss due to the backward development of this sphere of industry. It is also necessary to include certain interruptions in industrial and highway transportation, unjustifiable losses of industrial and agricultural products during handling, and other negative consequences.

Statistical data on the development of lifting and transport machine construction in the past 25 years reveal that the rate of growth of the production volume and labor productivity were high in 1960, but began to decline after 1965 and by 1982 had diminished respectively by factors of 3.7 and 2.5. The main cause, in our opinion, is lack of supervision of the sector. The enterprises, scattered over many regions of the country, are under different ministries. At the same time, the specialized factories for the production of lifting and transport technology are mainly low-capacity, technologically-backward enterprises with a self-contained production cycle of machines and articles--from the fabrication of the parts to the assembly and painting.

The measures in 1965 to improve the management of the economy left the lifting and transport machine industry almost untouched. The sector remained disorganized, i.e. there is no agency responsible for the development and enhancement of the technical level of the means of mechanization and automation of materials handling.

There is a similar situation with the construction of enterprises for the production of lifting and transportation technology, which in the early 1960s was distributed among various ministries. The reconstruction and respecialization of many plants are often done without adequate foundation, failing to consider the production of lifting and transportation equipment throughout the nation as a whole and in many instances for the solution of local problems. As a result, e.g., the reconstruction of the Ivanovo Automotive Crane Plant lasted 17 years, while that of the Leningrad Machine Manufacture Plant imeni Kotlyakov and the Lifting and Transportation Machine Manufacture Plant imeni Kirov, begun in 1964, is not yet finished.

The production base of the sector has been weakened by the transfer of a number of its enterprises to other ministries and their respecialization to manufacture of different products, namely, the Mogilev Automotive Plant imeni Kirov to the Ministry of the Automotive Industry, the Bryansk Mechanical Repair Enterprise to the USSR Ministry of Construction Materials, the Moscow Plant



Stankoagregat imeni 60-letiya SSSR to the Ministry of the Machine Tool Industry, the Syzran' Pipe Construction Plant to the Ministry of Power Machinery, the Sibtyazhmash to another executive authority of the Ministry of Heavy Machinery and so on.

The specific share of lifting and transportation equipment in Soviet machine manufacture is 1.5-2 percent. In 1983 the manufacture of its basic assortment was concentrated at 50 enterprises and sectors of the Ministry of Heavy Machinery and 62 enterprises and sectors of the Ministry of Construction and Highway Machinery. Furthermore, means of mechanization and automation for lifting-transportation, loading-unloading and warehouse work were manufactured at 322 plants and in the workshops and sectors of 40 ministries and offices. Around 140 organizations of various governmental affiliations were occupied with scientific research and experimental design in this field.

Automotive cranes are being made by 35 enterprises of 11 ministries, conveyers by 112 plants of 18 ministries and offices, and light lifting mechanisms by 30 enterprises of various offices. The demand of the economy for means of mechanization and automation of materials handling is satisfied by only 60 percent, while for certain types such as stacking cranes and warehouse equipment the figure is 35 percent, and for automotive and electric lift trucks it is 30 percent.

According to data of the TsSU SSSR [USSR Central Statistical Authority], in 1961-1965, the number of models built for new kinds and types of lifting and transportation technology comprised 1,101 titles, in 1966-1970 714, in 1971-1975 674, in 1976-1980 660. In the 10th Five Year Period their number diminished by 2.1 percent as compared to the 9th, or by a factor of 1.7 relative to 1961-1966. The renovation of the lifting and transportation means is being delayed by the slow development of the manufacture of new products, inadequate exploitation of the latest scientific and technical achievements in technological and design projects, unsatisfactory organization of the preparation of production of new machines and equipment, as well as the poor quality of materials and accessory parts. Thus, in 1967 the share of new products introduced for the first time in the overall volume was 11.3 percent, in 1975 5.7, and in 1981 only 1.7 percent.

As a rule, lifting and transportation technology is manufactured by non-specialized enterprises, many of which (owing to inadequate technological equipment) are on the basis of individual production. Despite developed and approved OST [Sector Standards], unification of the sector is at a low level, if not totally absent. According to investigations of the TsSU SSSR during 1983, in 58 newly-developed models of lifting and transportation equipment consisting of 75,400 parts more than 68 percent of the latter were original. This impedes the centralized manufacture of uniform parts and accessory subunits at specialized factories by the method of mass or large series production. The fabrication of machines in small lots, not infrequently from customized blueprints, causes increased expense. The rise in prices may be

judged, e.g., from the difference in net costs of similar products produced at various enterprises. Thus, the net costs of electric cranes of 30/5 ton and 50/10 ton capacity with spans of 32 m at a specialized plant are respectively 15,000 and 19,400 rubles, while at a nonspecialized plant 25,000 and 33,000 rubles.

The experience of Soviet and Western machine manufacture reveals that increased economic efficiency depends on the development and intensification of specialization, especially the centralized manufacture of general-purpose machine articles. Also of great importance is the unification of subunits and parts. Today the average level of unification of manufactured lifting and transportation machines and mechanisms is 45-60 percent. A sizable number of the unified subunits and parts are in general-purpose electric bridge cranes, conveyor belts and overhead conveyors alone.

The method of aggregation from unified subunits and parts can greatly curtail the volume of design work, the period of development of the new technology and optimization of pilot models, and the labor intensity of the fabrication. Thus, for long the Sibiryazhmash plant was unable to organize a series production of subunits and parts for large-capacity cranes. The reason was that previously all cranes had been designed from scratch, so that their designs were distinguished by great diversity. Today new designs are developed on the basis of extensive aggregation and unification of subunits and parts, even though the enterprise manufactures around 300 standard crane sizes. These products possess 85-90 percent unified subunits and parts, enabling an approximation to series production and the use of progressive technology. The Leningrad Plant for Lifting and Transportation Equipment imeni Kirov on the basis of creation and development of a standard series of gantry cranes has increased the number of unified subunits to 42. These have replaced the previous 226 subunits of individual design. As a result, the labor intensity was reduced by 50 percent, the weight by 15 percent, and the products were awarded the Seal of Quality.

Special Design Bureau No. 3 of the Ministry of the Automotive Industry (Minsk) has developed and introduced into production an overhead chain pusher conveyor with automatic addressing of the loads. It uses unified subunits and parts in the drive systems and advanced types of reducing gears, which has improved the reliability and durability of the conveyor several fold.

At the same time, the technical level of around 37 percent of lifting and transportation equipment is below that of the similar Western models; 6 models have been in series production for more than 20 years now. Only 5 models of no-rail electric floor transporters, accounting for 20 percent of the production, are among the best models; 4 models are due for modernization, while 11 are to be taken out of production. Of the 30 models of traveling gantry crane, 6 correspond to the highest quality category, 12 are in need of modernization and the others should be replaced. The backwardness in the production of high-quality accessory parts is telling here.

Because of the weak experimental and testing base of the scientific research organizations, the periods of development of new types of machinery and equipment are lengthened and the pilot models are inadequately prepared for series production. For example, general-purpose electric bridge cranes (unified lightweight models with capacity 5-50 tons) developed in 1972 were introduced only 10 years later. Not one of the 17 models of loading truck recommended for series manufacture in 1971-1980 is being produced.

Of great importance in the acceleration of the technical development of the sector is the proper choice of criteria in the evaluation of the economic activities. The science of administration recommends reducing the criteria to an interrelated system on the basis of maximum overall utility of products with minimum cost. Consequently, the projects of the plans must envision a combination of natural and cost criteria that will orient the industry to the manufacture of types of lifting and transportation machinery in short supply. For the present, there has been a trend toward cost criteria.

The planning of the production of lifting and transportation machinery is complicated by the lack of summary statistical accounting for the actual overall production in the country. As a result, some ministries indicate the volumes of production of such technology within the technological equipment, others within the nonstandardized, and only general-purpose equipment and means of mechanization of materials handling are accounted for separately. Nor is there consistency in the units of measurement. Thus, the enterprises of the Ministry of Light and Food Machinery report the manufacture of such products only in cost terms, the USSR Ministry of the Coal Industry in weight terms, and the remaining ministries in cost and physical terms. All this greatly impedes the acquisition of data as to the total volumes of production of lifting and transportation technology.

The estimation of the status of mechanization of auxiliary production may serve as an example of the use of the contradictory criteria. For long the prevalent criteria were the level of mechanization of lifting-transportation, loading-unloading and warehousing work and the degree of mechanization of the labor in such processes. Today 85-95 percent of the loading-unloading and warehousing operations in industry and transportation have integrated mechanization, but as many as 72 percent of those employed in materials handling work by hand. The relatively modest proportion of manual labor consumes the work of millions of people.

The replacement of manual by machine labor occurs under constantly increasing volumes of production, bringing an ever increasing volume of goods into the process of handling. This requires, in the first place, exact measurements and determinations, without which the planning and control of the actually-achieved levels of mechanization are impossible.

The current system for such accounting requires upgrading. Accounting form No. I-NT is mainly geared to statistical requirements, and not planning. The form consists of two sections: mechanization of loading-unloading jobs and availability of machines at the particular processes. The level of mechaniza-

tion is determined directly from the manufactured products. The process overlooks a sizable number of goods moved by hand, so that the classification of products as handled by mechanized means is done according to the primary working motion, regardless of the manual labor expenditure. Moreover, in the majority of cases the products are not comparable, or if they are, the labor intensity is different. For example, it is much lower in the movement of a single part weighing one ton than that of 1000 parts each weighing 1 kg. Therefore the index of work mechanization obtained in this manner will always be larger than the index of labor mechanization.

The accounting form does not include the volumes of work done by in-shop goods traffic, nor information about the utilization of the park of equipment and means of mechanization. The procedure for calculating the degree of mechanization of labor includes five types from total mechanization to manual. Such a gradation does not accurately reflect the actual state of affairs. In particular, the concept of "workers performing work by means of machines and mechanisms" is, in our opinion, dated, since it does not reflect the nature of the work and the actual degree of its mechanization. For example, the workers operating especially complicated machine tools and those working with screwdrivers, pneumatic chippers and other noncomplicated mechanisms cannot be reduced to a single category. Highly-qualified set-up adjusters of complex automated equipment are assigned to the fifth code and, consequently, an increase in their proportion lowers the level of mechanization of labor.

The structure of the park of lifting and transportation equipment needs improvement. At present the largest specific share belongs to the load-lifting machines, a significant number of which are due for modernization and updating. The consumers are forced to include these in the projects for mechanization of the materials handling, since requisitions for progressive kinds of continuous and floor transport machinery are poorly satisfied. The share of the latter in the total park of lifting and transportation technology is no more than 12.5 percent. The requirement for electric loaders is only 30 percent satisfied. This is further aggravated by a shortage of storage batteries. And if we consider the fact that their specific energy is insufficient, the actual requirement for electric loaders is even larger, owing to standstills for recharging. As shown by an investigation by experts of the VNII elektrottransport, the scarcity of alkaline and lead batteries results in roughly 20 percent of the park of electric loaders being in constant standstills. The disproportion in the manufacture of storage batteries and electric loaders creates bottlenecks, reduces the overall rhythm of the production process and inflicts serious economic losses on the economy.

Thus, in the lifting and transportation machine industry, proportionality as the major law and object of control is violated. The disproportions are largely due to the lack of a single central control agency for the sector.

There must be stronger influence of the customer on the producer. Improvement of the technical level and quality of lifting and transportation machinery will depend on this. The consumers have had to acquire such obsolete kinds of lifting and transportation technology as the EP-02 electric loaders, manu-



factured for 33 years now, the EP-201, manufactured for 19 years, the universal front loading trucks model 4022 of 2 ton capacity, introduced into production in 1961. The Kazan' Serp i molot plant of the Ministry of Heavy Machinery set up the manufacture of overhead load-carrying cableways more than 34 years ago and still supplies the equipment to the customers, while the Polevskoy Machine Construction Plant of the Ministry of Heavy Machinery has been manufacturing conveyor belts with belt width V-400, 500 and 650 since 1962. Many kinds of electric hoists of capacity 2 and 5 tons, several models of bridge cranes, as well as individual kinds of other lifting and transportation equipment have been manufactured for 20-25 years.

Essentially the manufacturer has no responsibility for the operating fitness of his products. Spare parts are also being produced in small volumes for obsolete machines. This state of affairs also derives from the fact that lifting and transportation technology is used in practically all sectors of the economy, i.e. it is clearly an intersectorial field.

In 1973 the CPSU Central Committee and the USSR Council of Ministers adopted a resolution "Measures for accelerating the development of production and improving the technical level of means of mechanization of lifting-transporting, loading-unloading and warehousing work in industry, construction and transportation." A broad spectrum of measures was outlined, aimed at substantial increase in the manufacture of technology, but not all were implemented.

In 1982 a complex target program was prepared for development of the production of lifting and transportation equipment. However the quotas of the complex program in terms of the 1985 volumes were approved in much smaller dimensions than were set by the aforementioned resolution for 1980. But even the reduced quotas fall short each year by 5-12 percent in terms of volumes of production, or 15-30 percent in terms of capital construction. The unsatisfactory growth of production and the technical level of these machines are holding back a reduction in numbers of those employed in lifting-transporting, loading-unloading and warehousing work.

The task of improving the production of means of mechanization has outgrown the limits of a single sector and become a national problem. It is necessary to identify clearcut and specific measures to overcome the backwardness of the lifting and transportation machine industry. The main point is to decide who will be responsible for the manufacture and supply of new and progressive means of mechanization and automation of materials handling for the nation. The delegation of four executive ministries to the production of lifting and transportation equipment--the Ministries of Heavy Machinery, Construction and Highway Machinery, Automotive Industry and Electrotechnical Industry--has not been warranted in fact. Not one of these is personally responsible for the status of the mechanization and automation of these processes.

In our opinion, the formation of the sector of lifting and transportation machine construction must begin with coordination of the activities of all the planning agencies involved in the problem, in order to develop the basic directions in the future evolution of the field, solve the problems of allo-

cation of enterprises and further upgrading of the structure of the manufactured equipment, strengthen the collaboration with the member nations of the SEV [Council for Mutual Economic Assistance] in the field of production of lifting and transportation technology, expand and intensify the international specialization and cooperation. In this way, conditions will be created for improvement of the existing system of planning of the manufacture of means of mechanization and the materials handling work.

The reorganization of the administration of the sector should be implemented in stages. This is primarily due to the fact that the industrial base is still very weak and decentralized. Many enterprises of other ministries are producing means of mechanization solely to meet their own needs and in negligible volumes.

At present we require the creation and concentration of a specialized base of the sector. Therefore the first stage should clarify the prospect of formation of an Executive Authority for Lifting and Transportation Machine Construction at the USSR Council of Ministers, paying attention to the experience from the development of the procurement sector (now the USSR Ministry of Procurement), the microbiological industry and others.

A two-component system of administration of the lifting and transportation machine construction will allow during the first stage a concentration, centralization and closer link between science and industry. Most importantly, it will permit a specialization and concentration of the production of equipment, both in the executive and other ministries.

In the second stage it is advisable to study the question of organization of a Ministry of Lifting and Transportation Machine Construction and intersectorial industries. With such a structure of control of the sector the achievements of scientific and technical progress in the implements for materials handling can be more fully included in current and future plans. A real possibility is created for achieving an optimal structure of the park of lifting and transportation technology on the basis of developing the production of the most progressive types: continuous and floor type no-rail transport and means of automation of the goods traffic. The formation of a centralized agency would allow the sector to be elevated to a qualitatively new level, accelerate the concentration and specialization of its scientific and industrial potential, develop ways of introducing mechanization and automation of materials handling processes in the sectors of the economy and thereby reduce the use of manual labor. The specialization and concentration of production and universal standardization and unification of parts and subunits will greatly lower the net costs of production and free a large number of nonspecialized enterprises of the other ministries from the production of lifting and transportation technology.

With a single coordinating agency it will be possible to implement a single technological policy, consolidate and expand the scientific-research and project-design organizations and the experimental and testing base, and



concentrate the majority of leading scientists working in this area within the confines of a single sector. Moreover it will be possible to attract scientists involved with problems of mechanization and automation at 40 higher institutes of learning around the country.

The importance of complex mechanization and automation of the processes of handling the objects of labor is especially heightened in conditions of flexible automated manufacturing. In our opinion the major directions of scientific and technical progress in lifting and transportation machine construction in the near future should be:

The development of lifting and transportation machines and complexes thereof with automatic control. Intensified scientific research and introduction of such equipment are dictated by the continuing decrease in growth of the labor resources and the need for further improvement of the human working conditions. Automated materials handling systems are becoming an important element of production. They enable an independent and time-coordinated operation of the main and auxiliary sectors, shorten the machine attendance time, and free up workers from performance of materials handling jobs.

Productions of machines with new and efficient methods of moving the load, development and extensive use of container transport systems, pneumatic transport, moving of loads by air cushion and induction floor carts, etc.

Production of machines that combine lifting-transportation and technological operations.

Improved structure of the lifting and transportation equipment by increasing the manufacture of new progressive machines for continuous and no-rail floor transportation.

Standardization and unification of the basic types of equipment and subunits.

Adoption of new drive systems and accessory parts and machines with enhanced ergonomic characteristics and environmental protection.

Only after raising the level of mechanization and automation of the secondary processes can we solve the problem of complex mechanization and automation of production.

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## INDUSTRY PLANNING AND ECONOMICS

### BALMONT LAUDS INNOVATIVE MANPOWER MANAGEMENT TECHNIQUES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Oct 84 p 2

[Article by B. Bal'mont, USSR minister of the machine tool and tool building industry: "Wide Road for the Brigade Method; Incentives for Collective Labor"]

[Text] Among the combination of measures making it possible to shift the industry onto an intensive development track, an important place belongs to improvement of the brigade form of the organization of labor at our enterprises. Of course, the principal goal of creating the new type of brigades is an additional increase in labor productivity. It should be noted that over the three years of the five-year plan period it increased by 19.7 percent in the industry versus a plan figure of 16.8, and by 6.8 percent in nine months of the present year as compared with the same period last year, versus 5.6 percent according to the plan.

No doubt, these results are associated to no small degree with the extensive introduction of a progressive form of labor organization. Now it has become the principal one at our plants--more than 60 percent of workers are united into brigades. And at some enterprises this figure is even higher: For example, it is 75.8 percent at the Orenburg Machine Tool Building Plant, 85.6 percent at the Kiev Machine Tool Building Association, and 90 percent at the Gomel Plant imeni Kirov. Much interesting know-how has been gained in collectives headed up by brigade leaders Hero of Socialist Labor V. Komarov, USSR State Prize Laureate V. Yermolayev, Lenin Komsomol Prize Laureate R. Belgarokov, and others.

At industry conferences of brigade leaders, held last year in Voronezh and this year in Ulyanovsk, there was serious talk about ways of improving the effectiveness of the brigade method, and about overcoming negative tendencies which have been observed. The fact is that in some collectives labor productivity growth rates have slowed as compared with the first years of their existence. Not a few brigades have also been identified which have allowed production quota failures. And, finally, as the extreme manifestation of these tendencies, a long line of collectives fell apart. This happened, for example, at the Berdichev Komsomolets [Komsomol Member] Plant, at the

Kharkov Production Association for the Manufacture of Aggregated Machine Tools, and at the Orelremstanok [Orel Machine Tool Repair] Plant.

Of course, these phenomena have forced our specialists to do some serious thinking and to become engaged in a thorough analysis of their causes. And what did the analysis demonstrate? In the initial period of its existence--the first one or two years--a brigade diligently realizes the potential lying on the surface, as they say: Workers actively intervene in the production process and introduce suggestions relating to changing operational production planning. It is precisely at this time that the multimachine operator system, the combining of trades and the exchange of know-how among workers become most widespread and discipline is increased. And as a result, maximum labor productivity for existing conditions is achieved in brigades and wages grow considerably.

But as soon as this internal potential is exhausted the brigade slows the pace gained. This inevitably takes place where there was not an integrated approach to creating the conditions necessary for successful operation of the brigade and where as a result a contradiction originated between the advanced form of labor organization and the existing working methods of the services involved in preparing for production and its technical support.

The whole trouble is that in many of the industry's enterprises the brigade has not become the primary system for organizing and managing labor. It is possible to cite not a few examples demonstrating that the formation and development of collectives takes place without serious restructuring of the production and management machinery, without reorientation of it toward the brigade form. Not infrequently managers and specialists of technical subdivisions and planning and work flow service personnel remain aloof from this process. And in these cases, of course, preparation for production and its planning and standardization, not having undergone changes by taking the new requirements into account, cease to conform to the goals and principles of the brigade movement.

Here is one example. Although steady outdistancing of the rate of growth of wages by the rate of growth of labor productivity has been made possible for the industry as a whole, recently in individual collectives the relationship between these indicators has been upset. For example, at the Tbilisi Machine Tool Building Association, the Novosibirsk Tyazhstankogidropress [Heavy Machine Tool and Hydraulic Press] PO [Production Association], at the Lvov Milling Machine Plant, at the Kostroma Woodworking Machine Plant, and at the Ryazan Tsentrolit Plant, wages have unjustifiably increased in brigades with a reduction in the rate of growth of labor productivity.

Why has this taken place? The following must be stressed: The importance of proper technically validated norm setting increases especially under conditions of the brigade form. On the other hand, in some places the practice has become ingrained whereby the implementation of management engineering measures, as well as the streamlining of production at the initiative of the workers themselves are not accompanied by a review of existing production norms. And this means that the enormous amount of money spent on retooling

and the improvement of labor organization do not realize a full return in terms of improvement in the efficiency of this labor.

Even integrated production norms are far from always an incentive for an improvement in productivity. After all, they are often set by the simple summation of individual operating norms intended for pieceworkers working individually, without taking into account the advantages of collective labor.

Of course, the shortcomings under discussion are characteristic not only of our industry alone. Here there are evidently not only subjective, but also objective causes. One of them is doubtlessly the following: The period of the formation of the new type of brigades has taught us much, and now we clearly see the problems confronting us at the next stage. Now measures have been developed in the industry which are based on the principal tenets of the CPSU Central Committee's decree "On the Further Development and Improvement of the Effectiveness of the Brigade Form of Organization and of Labor Incentives in Industry."

The analysis of the work of many collectives has demonstrated that the ways of improving production efficiency on the basis of the brigade method are determined to a considerable extent by the specifics of the subindustry and enterprise. In other words, here there cannot be a single standard, a prescription for all of them. And nevertheless general trends in the development of brigades exist to which it is necessary to direct our attention primarily.

In this connection, in the industry several base enterprises have been singled out for the purpose of working out individual design solutions and alternatives for organizing, standardizing, remunerating and providing incentives for labor in brigades. For example, the Gomel Machine Tool Building Plant has been assigned problems relating to management-engineering preparation for production, improving the management of brigades, as well as the development of brigades including engineering and technical personnel and foremen in their structure. At the Lipetsk Machine Tool Plant the brigade form in ancillary production is being optimized, in repair services at the Ryazan Machine Tool Building Association, in sections of machine tools with numerical program control at the Minsk Association (men) the October Revolution, and at the Kiev SPO [Specialized Production Association] attention is being paid to problems of socialist competition within brigades and between them.

This system makes it possible to study more thoroughly each direction for improving the brigade form and to introduce it at other enterprises more knowledgeably, on the basis of accumulated experience.

A special place is being set aside for the improvement of norm setting. At the Orgstankinprom [State Planning, Technological and Experimental Institute of Organization of the Machine Tool and Tool Building Industry] NPO [Scientific Production Association] a procedure has been developed for calculating integrated norms especially for the brigade form of labor organization. Its introduction in the industry's enterprises will begin in the very near future.



It should be noted that our specialists long ago came to the conclusion that it is better to entrust to production engineering services the setting of norms in key production--this ensures the more qualified calculation of norms. Now, based on experience already gained, 60 enterprises could convert to the computer-aided design of production processes with the simultaneous setting of norms on computers. At the same time the conditions have been created for an objective evaluation of the results of labor in brigades and for their calculation according to the no-job-order system. This has been testified to by the experience of the Leningrad SPO imeni Sverdlov, the Gomel Plant imeni Kirov and a number of other enterprises.

One way to improve production efficiency is to expand further the area of application of the contract form of labor organization and the extension of it to higher production levels. In this connection, the experiment being conducted at the Novosibirsk Tool Plant in the clamping tool shop, where more than 500 people work, deserves attention. Here salary raises for engineering and technical personnel depend on the figures of brigades.

An important trend also is the orientation toward the creation of large integrated start-to-finish brigades. We are convinced that it is precisely this kind of collective which makes it possible to synchronize the production process in the best manner and to reduce to a minimum pauses between operations. It is precisely here that a broad-profile worker is formed, because of which a brigade reacts more flexibly to a negative external influence. Finally, in these brigades there is the ability to create primary party and social organizations, which makes them full-fledged labor cells. Now 40 percent of workers are working in integrated brigades in the industry, and work is under way to develop them further.

In industry measures such assignments have been called for as carrying out the certification of work places, expanding the multimachine operator system, training brigade leaders, and spreading the brigade form among engineering and technical personnel according to the experiment by the Ulyanovsk GSKB [Head Specialized Design Bureau] for Heavy-Duty and Milling Machines, etc. Their implementation will certainly make it possible to improve the utilization of the potential for improving production efficiency. That this potential is great is testified to by at least this fact: In integrated brigades, where their creation was combined with the serious restructuring of the entire production process, labor productivity increases by 15 to 20 percent, which is considerably higher than the average figure for brigades.

The expansion and intensification of brigade cost accounting requires special attention. Unfortunately, for the present only 10 percent of our brigades are cost-accounting. Of course, there are not a few complexities here. But it is very important to introduce the elements of cost accounting even in those cases when it is possible to account for if only one kind of material resource whose consumption a brigade can actively influence. The experience of such enterprises of ours as the already mentioned Gomel and Lipetsk plants and of the Kiev Machine Tool Building Association has been convincing in this respect.

Conducive to the further development of brigade cost accounting will be the decision taken regarding participation of the industry in a wide-scale economic experiment aimed at increasing responsibility for the end results of work. The role of economic norms is being increased at enterprises and there will be expansion of the administration's rights to utilize wage fund savings for the purpose of rewarding collectives which operate with a reduced staff, for the combining of trades, for the efficient utilization of material resources, and the like.

Certainly, improvement of the brigade form of labor organization on the basis of the measures developed requires additional effort on the part of all collectives and managers of enterprises. We must be aware of the fact that this is one of the most important ways of improving production efficiency, of intensifying production, and of ensuring successful operation of the machine tool building and tool industry.

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## INDUSTRY PLANNING AND ECONOMICS

### RESULTS OF ECONOMIC EXPERIMENT PRESENTED

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[Article by K. M. Cherkasova, Deputy Department Head, USSR Ministry of Finance: "The Machine Building Ministries under New Management Conditions"]

[Text] Since 1984 a large-scale economic experiment has been under way in the 5 industrial ministries, during which time new management methods are being tested.

These methods are being disseminated to a number of sectors of machine building, ferrous metallurgy, the food and light industries, local industry and domestic services for the public, taking into consideration accumulated experience and specific nature of activity.

The first results of the economic experiment permit us to draw a conclusion concerning the effectiveness of the management forms and methods being introduced. The results of the experiment at enterprises of Mintyazhmash [Ministry of Heavy and Transport Machine Building] and Minelektrotekhprom [Ministry of the Electrical Equipment Industry] attest to an increase in the level at which plan quotas have been fulfilled (Table 1).

During the course of the experiment being conducted within industry, it has been envisioned that the effectiveness of the standardized method of profit distribution will be increased. The new method of profit distribution is more closely associated with the entire complex of the management mechanism, and its application takes the current capabilities of the economy into consideration to a greater extent.

A decentralized order of settlement with budget according to accepted standards has been introduced, which increases the responsibility of the enterprises. Enterprises enter payments into the budget from settlement profit actually received on the basis of a confirmed standard. Payments into the budget from profit consist of a fee for fixed production capital and standardized working capital and withholdings from settlement profit on the basis of a confirmed standard.

The standard for withholdings from settlement profit into the budget is confirmed in the annual plans for the ministries and are accordingly brought to the enterprises. Established norms are not subject to change.

TABLE 1  
(%)

	Mintyazhmash				Minelektrotekhprom			
	1983		1984		1983		1984	
	fulfillment of plan	growth rate	fulfillment of plan	growth rate	fulfillment of plan	growth rate	fulfillment of plan	growth rate
Extent of realization	101.0	105.0	101.2	105.9	100.9	104.9	101.4	106.1
Extent of realization taking shipments into consideration	94.5	105.1	99.2	110.9	96.9	104.0	99.0	107.8
Actual growth rate of labor productivity	X	105.4	X	107.6	X	106.4	X	107.4
Industry profit	99.8	112.1	108.1	118.5	104.3	113.1	111.1	118.9
Payment into the budget	100.3	113.6	103.3	105.1	115.5	127.4	110.8	152.3
Relative importance of payments into the budget in the total sum of profits	33.4	X	28.0	X	15.9	X	20.3	X

Given fulfillment and overfulfillment of the plan for profit, the actual accounting profit is directed into the budget according to a confirmed standard at a rate not less than the sums of payments specified by the financial plan and toward settling enterprise expenditures, with payments from above-plan profit produced on the basis of the same standard as from planned profit.

Specific special benefits are created in financing the costs of an industry. Thus, in the case of inadequacy of sources determined by active conditions for withholdings to go into the economic bonus fund for fulfillment of quotas and commitments for delivery of products from the products list and within the deadline in accordance with signed agreements, deductions from profits to go into the budget are reduced. Moreover, given underfulfillment of the plan for profit on the order of 2 percent, the enterprises introduce into the budget standardized deductions from the accounting profit in amounts established by plan at the expense of a corresponding reduction in the profit remaining at the disposition of the enterprises. In the case of underfulfillment of the plan on a large scale, the deductions into the budget and the portion of the profit remaining at the disposition of the enterprises are reduced in corresponding proportions according to a set standard.

At enterprises of Mintyazhmash and Minelektrotekhprom, a supplementary charge (above that which has been established) is being paid in for above-norm stores of commodity goods and uninstalled equipment which has not been credited by the bank to the extent of 3 percent of their value. It is being directed toward financing the ministries' expenses, the requirement for which will appear over the course of fulfillment of the plan. The supplementary charge for above-plan producer goods is being paid in at the cost of unused actual accounting profit remaining at the disposal of the enterprises.

An order is being established among enterprises of the machine building ministries which have converted to operation under the conditions of the economic experiment since 1985, whereby a supplementary charge to the extent of 3 percent of the value of above-norm stores of commodity goods and uninstalled equipment not credited by the bank at the expense of the portion of the profit remaining at the enterprise's disposal is directed into the budget.

In an evaluation of the new approach to application of the standardized method of profit distribution, it is also necessary to take into consideration the fact that enterprises have been permitted to generate a financial reserve at the expense of unused actual accounting profit, that the periods of time for utilization of payment credit have been extended and that the standardized method of profit distribution itself emerges as one of the components of a whole complex of interrelated supplementary measures for improving the management mechanism.

Analysis of the new system for profit distribution permits us to single out the following fundamental features:

- standards of profit distribution between the economy and the budget are not set for ministries, but directly for enterprises on the basis of their annual financial plans;

- it is not the total amount of profit remaining at the disposition of the enterprise which is determined by a standard, but the withholdings into the budget from the accounting profit, with standards being set for the majority of enterprises in percentages of the accounting profit;

- less strict forms of guarantee of payments into the budget are being employed so as not to aggravate the position of enterprises which are in difficult financial straits;

- privileged conditions are created with the formation of a material incentive fund for meeting commitments for deliveries;

- a decentralized order of calculations based on payments from profit has been established, whereby enterprises settle with the budget independently, proceeding from set standards, while local financial bodies monitor the timeliness and completeness of these settlements and the financial-management activity of the enterprises on the whole.

The effectiveness of the action of the profit distribution mechanism is determined first of all by the extent to which it promotes the resolution of such problems as stimulation of the growth of capital accumulation, creation of interest in the efficient utilization of producer goods and increasing the responsibility to the budget for fulfillment of planned quotas and commitments.

Analyzing the results of the operation of Mintyazhmash and Minelektrotekhprom enterprises, one may draw the conclusion that the size of the profit left at the disposition of the enterprises grew in comparison with the plan to a greater extent than profit itself and payments into the budget. The level of overfulfillment of the plan for payments into the budget is significantly lower than overfulfillment of the plan for profit, which attests to the fact of growth rates for withholdings into economic stimulation funds moving ahead. Thus, throughout Mintyazhmash in 1984, the profit growth rate was 118.5 percent, payments into the budget from profit was 105.1 percent and the profit remaining in the industry grew by 134.5 percent.

Such a position is precipitated in many cases by the fact that the fund-generation mechanism is not linked with profit, neither with the source nor with the extent of fund generation. The order for withholdings into the material incentive fund for fulfillment of the delivery plan exerts considerable influence on the actual proportions of profit distribution between the budget and the industry.

In 1984 throughout Mintyazhmash, withholdings into the material incentive fund increased by 34.8 million rubles as compared with 1983, or by 30.3 percent. For 1984 149.8 million rubles have been directed into the material incentive fund, including 40.4 million rubles above the plan, and of this amount withholdings from surcharges for efficiency and for the Mark of Quality comprised 24 million rubles and supplemental withholdings for fulfillment of the plan for realization taking delivery into account made up 5.5 million rubles.

At the enterprises operating under the conditions of the experiment, the level of satisfaction of commitments for deliveries increased noticeably. Thus, if in 1983 overall throughout Mintyazhmash the plan for extent of realization taking deliveries into account was met at 94.5 percent, in 1984 commitments for deliveries were met at 99.2 percent. Quotas for deliveries were met by Minelektrotekhprom at a rate of 99 percent in 1984 (96.9 percent in 1983).

Moreover, the increase in the level of meeting contractual commitments is occurring with negligible improvement in fulfilling the plan for production of the most important product list. In 1984 the plan was not fulfilled for 19 out of 40 descriptions of the most important products. As a result of, shortcomings in the organization of production, the national economy was undersupplied with blast furnace and steel smelting equipment, rolling equipment, overhead electric cranes, etc.

At a number of enterprises when quotas are fulfilled on the extent of realization taking deliveries into consideration, the plan is not fulfilled throughout the entire product list. This is caused by the fact that contracts do not include the entire planned extent of realization, which creates favorable



circumstances for meeting the extent of deliveries and increasing withholdings into the material incentive fund at the expense of a reduction of payments into the budget.

A situation has been created wherein the fewer the orders, the easier it is to meet all the deliveries. The supplier finds diverse possibilities for refusing to conclude contracts: errors in specifications, not meeting deadlines for contract negotiation; there are instances when supply authorizations are overstated for an export product and an export product not covered by contracts does not come into the internal market for conclusion of contracts in a timely fashion. Moreover, a part of the contracts not satisfied for the previous year are transferred over to the next year without a more precise definition of the plan for the products list, as a result of which the entire planned products list is not covered by contracts.

Thus, for example, the Kaluga PO [Production Association] of track machinery and hydraulic drives did not meet quotas in 9 of 31 descriptions on the basic products list while meeting their plan for deliveries, with only 96 percent of the planned extent of realization being covered by contracts. The plan called for the association to produce 220 hydraulic transmissions for repair needs, and in fact only 180 items were produced, with only 178 hydraulic transmissions being covered by contracts. The production of modus [mode of production] spare parts was planned in the amount of 500,000 rubles, and they were actually produced in the amount of 294,000 rubles, with only 292,000 rubles of this product being covered by contracts, or 58 percent of the plan. This situation permitted the association to account for complete fulfillment of contracts and produce additional withholdings into the material incentive fund in the amount of 278,000 rubles, and at the cost of a reduction of 34,000 rubles in payments to the budget.

Along with this, there occurs an irregular spacing of the plan for deliveries by quarters, which permits the enterprises to account for fulfillment of reduced plans and make 15 percent supplemental withholdings into the material incentive fund during the course of the year. The "Uralmash" Production Association concluded contracts for 18 percent of their annual delivery in the first quarter of 1984. Contracts for shipment of 15.6 percent of the annual output of the TCK-2 diesel locomotive were concluded in the first quarter by the Production Association of Track Machinery and Hydraulic Drives.

Enterprises of Mintyazhmash which fulfilled the plan for deliveries in 1984 withheld an additional 7.6 million rubles for the material incentive fund, with only 1.6 million rubles coming at the expense of above-plan profit, while 6 million rubles came from reductions in payments into the budget.

The shortfall of their own resources for supplemental withholdings for the material incentive fund is linked to no small extent with the fact that accounting for meeting commitments for delivery is taken based on shipped and not on realized product.

The introduction of accountability for authorization by contracts for orders issued by bodies of USSR Gosplan will permit the level at which the set plan is met throughout a products list to be increased. It is necessary to introduce such an order of accounting for satisfaction of contracts, whereby the extent of realization taking shipments into consideration is considered to be met if all products for which orders have been issued are covered by contracts. In the event that a contract cannot be concluded due to objective reasons, it is necessary to specify the confirmed plan for the products list more precisely in accordance with established procedures. It would be considered that a delivery plan has been fulfilled only when the plan for the basic products list has been fulfilled.

It is expedient to make supplemental withholdings to go into the material incentive fund for meeting the plan for deliveries, given satisfaction of quotas throughout the basic products list at the expense of above-plan profit or assets of the enterprises' and centralized funds of VPO [ All-union Production Association ] and the ministry to increase effectiveness of the profit distribution mechanism, and not at the expense of reductions of payments into the budget.

The enterprises of ministries participating in the experiment reduced the directing of assets of the social-cultural measures fund into the financing of housing construction. They prefer to use centralized capital investment to this end and cover expenses for operational maintenance of cultural and domestic projects using the social-cultural measures fund. Thus, if in 1983 22 percent of the fund was utilized throughout the Minenergomash [Ministry of Power Machine Building] for financing housing construction, only 4.4 percent is allocated to this end in the plan for 1985. The corresponding indicators throughout Mintyazhmash are 38 percent and 10 percent. In this regard, it makes sense to set a limiting standard for expenditure on housing construction of the assets of any given fund.

With the formation of a fund for production development, a start was made toward cost accounting financing of corresponding expenses. At the enterprises operating under conditions of the experiment, the size of the funds is in direct proportion to the rates of growth of profit and amortization deductions for the total restoration of fixed capital. This affects work quality positively. The size of the fund depends on the source for its generation.

It is necessary to provide for fulfilling these operations using primarily a subcontracting method for realization of the capability of independently implementing retooling using the production development fund, having specified them in the state plan, and not through a management method, as is specified by conditions of the experiment.

In accordance with the conditions of the experiment, the size of the planned development fund overall throughout the ministry is determined on the basis of the total of the enterprises' planned funds, which may result in the formation of a fund not guaranteed by sources.

According to the plan for 1985, throughout Minenergomash the total size of the production development fund, determined proceeding from the set standard,



is 78.9 million rubles (73.7 million rubles from amortization deductions and 5.2 million rubles from receipts from the realization of retired property). However, the production development fund determined by estimate in accordance with the situation of the total of all plans of the enterprises equals 79.7 million rubles (74.5 million rubles from amortization deductions).

Such a situation arises because the growth rates for amortization deductions among individual enterprises exceed the average industry-wide rates on the whole.

Another problem, associated with the fact that a fund cannot be redistributed and withdrawn from the enterprises, arises when utilizing the production development fund. The size of the production development fund exceeded the volume of noncentralized capital investments among individual enterprises. Thus, according to the plan for 1985, among the individual enterprises of Minkhimash [Ministry of Chemical and Petroleum Machine Building] the production development fund exceeded the volume of retooling by 16 million rubles, and this sum was replaced with a long-term credit for financing centralized capital investments. In our opinion, it is expedient to establish differentiated standards on an enterprise basis for generation of the production development fund taking into consideration the depreciation of primary production funds and plans for retooling.

Enterprises participating in the experiment have been permitted the right to generate a financial reserve. Only a negligible number of enterprises took advantage of this right, which is explained an inadequacy of sources and, foremost, of free actual accounting profit. Enterprises prefer to direct incentive surcharges into economic stimulation funds. Thus, in the first half of 1984 only 7.5 percent of enterprises in Mintyazhmash made withholdings into a reserve and 36 percent in Minelektrotekhprom. The size of the reserves which were generated was negligible -- from 0.06 percent to 0.7 percent of the standard for internal working capital. However a demand exists for a financial reserve at many enterprises. In connection with this, one cannot but note the need for allowing greater rights in spending the assets of a reserve. It is necessary that they be permitted to direct them toward an increment in interman working capital, to use them for withholdings into the material incentive fund for fulfillment of the plan for deliveries or for insuring guaranteed payments into the budget from accounting profits.

A significant role in solving the problem of increasing the efficiency with which fixed production capital and working capital are used belongs to the charge for the funds. Practice has shown that the stimulating potentials of the charge for funds are being incompletely utilized first of all in connection with the existing system of benefits, with the inadequate level of profitability, with the presence of unprofitable enterprises and with the high relative share of profit directed toward financing planned expenses. Therefore in a number of machine building ministries, low standards of charges for funds have been set. Thus, in 1984 the standard throughout Minenergomash was set as 0.07 percent of the cost of production funds, and 1.6 percent throughout Mintyazhmash and Minelektrotekhprom.

Among enterprises participating in the experiment since 1984, the influence of the charge for production funds on reduction of above-norm funds has been reduced since the supplemental charge for above-norm production funds is paid in from the profit remaining at the disposition of the industry toward financing the ministry's expenses, and is not included in the budget, with the enterprises realizing it at the expense of the free accounting profit, not reducing the size of incentive funds.

A total of 2.3 million rubles supplemental charge came to Minelektrotekhprom for 1984 (0.8 percent of the cost of above-norm stores of commodity stocks and uninstalled equipment), with the above-norm uncredited stores of commodity stocks and uninstalled equipment equaling 298.7 million rubles.

It is possible to further generate a fee for production funds in that instance when a close interconnection has been established among the extent of utilization of production funds, the measure of material incentive and the financial status of an enterprise. At present, the fee for funds is called for in the plan and has no effect on incentive funds and the financial status of the enterprises.

The introduction of a charge just for above-norm stores of commodity stocks and uninstalled equipment not credited by the bank at the rate of 6 percent will be a more effective lever in stimulating better utilization of production funds. Moreover, it should be paid into the budget from the actual profit remaining at the disposition of an enterprise.

Generalizing the results of operation under conditions of the experiment, one may single out a number of problems, the resolution of which will permit the efficiency of the profit distribution mechanism to be increased. Payment of percentage points for the use of overdue bank loans is connected with the unsatisfactory operation of the enterprise and therefore should occur only at the expense of the profit remaining at its disposition. Under the conditions of the economic experiment, the total sum of percentage points paid for the use of bank loans is excluded from actual profit. Under these conditions payment of percentage points for overdue loans occurs partially at the expense of reductions of payments to the budget and of the profit remaining at the disposition of the enterprise. It was for this reason that payments into the budget were reduced by 0.6 million rubles in 1984 just among enterprises of Mintyazhmash and Minelektrotekhprom. It is expedient when determining actual accounting profit to take percentage points for bank credit into consideration, with the exclusion of those paid for overdue loans.

The preservation of the stability of economic standards and calculation of concrete conditions of their operation are a most complex question. To a significant extent, this stability is a function of the type of standard.

Standards for withholdings from accounting profit going into the budget are determined on the basis of annual financial plans proceeding from size of profits and demand for capital for financing planned expenses which have arisen according to the plan. It was surmised that such an order would permit concrete conditions of enterprises' activity to be taken into consideration more

fully and insure the stability of standards for withholdings from profit. As a result, the standards for this payment are diverse. They have been set at a low level at many enterprises. According to the plan for 1984, the size of withholdings throughout Minelektrotekhprom going into the budget from accounting profit have been set at a level of 10.4 percent. Among the enterprises, these standards fluctuate from 1 percent to 33.8 percent.

The standard for withholdings from profit for 1985 throughout Minenergomash has been set at 7.8 percent. These standards have been set for 17 profitable enterprises. However, they are of a purely symbolic nature since their size is equal to from 1.1 percent to 7.5 percent of accounting profit.

The standard for withholdings from accounting profit is determined on the basis of profit, the charge for production funds and the percentage points paid for bank credit, of which only the last two are stable. It follows from this that it is not always possible to keep the standard for withholdings from accounting profit stable. However, an orientation exclusively on the principle of the stability of the standard for withholdings from profit results in its losing any connection with the plan, and in a number of cases to budget losses. Moreover, it follows to strictly limit the refinements introduced into financial plans of enterprises after having raised the planning level.

A stable standard confirmed for a 5-year period is being used at the Sumy Machine Building Association imeni M.V. Frunze. The main principles of the production association's operation under the new conditions consist in withholdings going into the state budget and the generation of funds for economic stimulation are made from profit on the basis of stable, progressive standards. Retooling of production, the financing of renovations and new construction associated with the expansion of active factories are realized at the expense of the association's internal capital (profit, the production development fund) and long term credit from USSR Stroybank [Bank for Financing Capital Investments]. Planned expenses are financed at the expense of the association's internal profit; covering them with the aid of a redistribution of the ministry's assets is not envisaged. The free profit remainder is directed into the production development fund according to the plan and the accounting after covering the association's expenses.

Financing housing construction and social-cultural and domestic projects with the expansion of active enterprises and new construction is realized by drawing assets from centralized sources, whereas with retooling and renovation of an association, it is only at the expense of assets of the social-cultural measures and housing construction fund.

A standard for withholdings into the state budget from profits is confirmed for an association in the 5-year plans, and is not subject to change. The association makes payments into the budget independently on the basis of the set standard, which is determined proceeding from the correlation between profit and payments into the budget provided for in the plan for the base year, with withholdings being made taking into consideration the progressive growth of the standard from year to year in the 5-year plan. A fee for production funds is not set for the association.

The profit remaining after withholdings to go into the budget, payment of percentage points for credit and the generation of economic stimulation funds is directed toward planned expenses. The remainder of the undistributed profit is actually directed into the production development fund in excess of the set standard, according to plan.

The following primary indicators characterize the activity of an association in accordance with its calculations (Table 2).

Table 2

	11th 5-year Plan	12th 5-year Plan (projected)	Devia- tion	Growth Rate (percent)
Increment in production due to labor production (%)	84.4	93.5	+9.1	
Balance profit, mill. rubles	192	434	+242	226.0
Payments into the budget, in all-- mill. rubles	33.3	127.5	+94.2	382.9
Profit remaining at the disposition of the association, mill. rubles	147.7	282	+134.3	190.9

The association is not deciding to go over to total cost accounting since should difficulties arise as a result of not fulfilling the plan for profit, payments into the budget are corrected at the rate of nonfulfillment.

When the profit plan is not fulfilled at a rate up to 2 percent, the payments into the budget which are specified in the plan are paid in in the full amount, and when the plan is underfulfilled at a rate greater than 2 percent, withholdings going into the budget and distribution of profits is made in the corresponding proportions.

The results of the activity of ministries operating under the conditions of the economic experiment permit the conclusion to be drawn that the standards method of profit distribution in combination with other measures influences the operation of enterprises positively. In all of the machine building ministries working the new way, profit growth rates increased, and planned quotas for profit and payments into the budget are being met. The stimulating capabilities of the standards method of profit distribution will increase as the individual elements of the standards method are specified more precisely.

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### RELIABILITY PROBLEMS WITH IMPORTED MACHINE TOOLS NOTED

Riga CINA in Latvian 14 Jun 85 p 2

[Article by A. Gavare: "In the Complicated Machinery World"]

[Text] The Daugavpils electrical instrument factory's small series production or experimental department has changed beyond recognition. In one corner stand two elegant Austrian made "Linzinger" machines for producing perforating drills, in the other corner can be seen the orange carousels of a machining center. The upper floor houses a modern heat-treatment line, a dimension measurement machine from the Federal Republic of Germany, automated milling machines, and other equipment. There are new items also in other departments. Problems with electronic circuits, components and devices oblige us to use imports. The machining centers from the Ivanov machine building firm and other advanced equipment is also supplied by other factories in our country. This year we will have a total of sixteen machine tools with numerical control systems, but more will be needed in the future, because, as the factory's chief engineer Anatolij Murnikov explained, individually this equipment does not have a major effect; it is more advantageous to place it in a common technological services. It is planned in the future to equip several machines with industrial manipulators.

Although recapitalization has not begun in earnest at the electrical instrument factory up to now (that will begin only in 1987), some modernization of production has been accomplished within the old walls. That was driven by the need to specialize, to change electrical tool models, and to improve their quality.

The production planning department's manager, Leokadija Ozolins, maintains that, due to new technology, about a seventy percent increase in work productivity has been attained. Consequently, 102 workers were released [one worker can monitor two or more automatic machines]; more than eighty tons of metal and a considerable amount of electricity and heating energy were saved. A progressive technology is acquired along with the new system; hot punching of components, casting metal under pressure, powder metallurgy, and metal substitution with plastic.

The punching department's plastic production area men are very satisfied with the automatic equipment made in the German Democratic Republic.

"The production volume grows, but the same ten punch operators remain in the team," tells the area foreman Peteris Dzenusko. "Work proceeds especially well in fabricating instrument cases. Before, each component had to be made individually, but now the machine casts one whole side at once. Of course, metal is also saved".

At the moment two of the five imported machines set-up in the area stood idle; one still had to be installed, the other required some repair. In those situations where the warranty period has not elapsed, a specialist usually must be summoned from the supplier; meanwhile one patiently waits, doing nothing. It is still worse, if the reason for idleness is one's inaction or inexperience. In March, for example, one of the high-volume machining centers was down for nearly a whole month; due to the lack of experience the set-up man ruined an important part, for which one had to travel to Ivanov.

"We still have not found the new system's weak points," says A. Murnikov. "We should look at least two years ahead and order now the necessary spare parts; however, that has not always been possible."

It must be remarked, that the factory's repair service has become more capable because already for the fourth year it functions as a centralized sub-unit. Several specialists have supplemented their education outside the country or through in-house courses. Peteris Tiavans, a graduate of Riga's Polytechnical Institute, has a good understanding of the new technology and provides good support to the programming group. However, everything cannot be predicted in advance and complications with repairs are unavoidable. Unfortunately, that is attributable not only to the new technology alone.

Last year's budgeted capital improvement plan was exceeded by sixteen thousand rubles; this year an additional two-hundred thousand must be requested from the ministry. What "eats-up" these sums? While searching for the answer, let's take a look at the structure of the factory's machine fleet. Twenty-three percent of the total metalworking machines have been in service for more than twenty years, forty-two percent for ten to twenty years. Last year sixty-two worn-out and obsolescent items were depreciated and sold, or six percent of the total. Viewed separately, this indicator is high; nationally, the average depreciation is about 2.5 percent per year. It is not difficult to calculate how many five-year plans have to pass before the entire order is replaced. Therefore, repairs still will require more time and expense than predicted by the standard, but the coefficient of change for equipment will not exceed the present 1.6 by much. Just about now that should become more influential; the most expensive and productive machinery operates this year on three shifts.

At present, throughout the country modernization of production equipment is well under way: continuous casting of metal parts has relieved work stoppages. It is an advantage when the machine is programmed for such functions already in the forming stage and work stoppages eliminated. On the other hand, modernization can cost more than the acquisition of a new system.

"Last year we converted only two milling machines," said Va'entina Piskin, manager of the new technical group. "There is an effect. But where the necessary parts were found and acquired, is best kept quiet. We hope to modernize four machines this year. However, expansion of the service zone will be minimal.

Hopes are not especially high, but it is also understood that one cannot fly about in the clouds."

In trying to grasp the factory's total economic picture, one gets the impression that there are two sides to it. Successful progress (comparing actual performance with the planned and prior level), broad market penetration (also internationally) of the produced goods, victory in the socialist competition, yet in contrast, or more precisely, behind all this--a certain lagging, large expenses, disproportionately large overall work load, which is all invested in the end product. Indeed, output in the prior year grew by 7.3 percent, and that is commendable, but the budget allocation for the same period increased by thirteen percent. The output volume of manufactured goods has shrunk per budgeted ruble. That is not a local phenomenon, and here the factory's collective cannot be blamed. The budget payback has decreased due to the new system's cost discrepancy relative to productivity. For example, one of the old turret lathes in its time cost thirty-five hundred rubles, the new one is nine times more expensive. On the other hand, labor productivity grew only two-fold. Workers in the short series department say that one (fortunately only one) recently installed machine produces in a shift only half as many parts as the old one. One could ask, why was it acquired. The factory management sometimes has little say--they have to take what is offered.

In its own way, the net normative output index, on which the wage fund depends, is salvation for the collective. Still, the present relationships among the budgeted amount, its return, and work productivity cannot make one happy.

What will the factory workers do? As much as possible free themselves more energetically from the old, low productivity system, more fully encompass the new, and on that basis increase productivity. Obviously the contact signing practise could be broader in scope with the local machine repair shop, which has specialized in system rebuilding. The developing engineering potential must be put to use skillfully. True, also their work intensity now to a degree is dictated by new designs, by mastering the new technology, and by modernization and rationalization. However, these factors are transient. The wage fund, the rate of return, and size of the engineering staff do not change in one year. Therefore, it is natural to have periods of over-utilization and also under-utilization. The work participation coefficient, specialist initiative groups --all of which would ensure a greater volume of work in smaller numbers, creates a weak response. Something is tried, started, but not carried to completion. In the electrical instrument factory, for every five workers there is one technical engineer. High or low? In the small series department, for example, the view is that engineers are in over-supply, but that there is a shortage of workers who would supervise the system on second and third shifts.

As concerns increased production, it is possible to find more than one lever that would work for the good of a common economic effect. The world of machines is complicated and also quite conservative, but then it is run by people.

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### PRODUCTION, IMPLEMENTATION OF NC MACHINE TOOLS IN ARMENIA

Yerevan KOMMUNIST in Russian 10 Aug 85 p 2

[Article by S. Geodakyan, general director, Armstanok Scientific Production Association, under the rubric "The Economic Manager's Rostrum: "Machine Tools for Tomorrow"]

[Text] Machinebuilding is called upon to play a most important role in intensification of production, toward which the country's entire economy is moving today. In turn, as was noted at the June CPSU Central Committee meeting devoted to accelerating scientific and technological progress, the heart of machinebuilding is machine tool manufacturing, which must create the prerequisites for the most rapid retooling of enterprises.

Recently I read with interest an article in the newspaper KOMMUNIST by G. Yeritsyan, general director of the Charentsavan machine tool association, entitled "Machine Tools Today and Tomorrow," which raised problems facing the branch's enterprises in the republic. I would like, in turn, to share some of my own views.

Each year the republic's machine tool branch grows stronger and accumulates advanced experience and traditions. Production volume has increased significantly; plants have expanded; the range of machine tools, equipment and specialized tools manufactured has increased; and their models and types have been updated.

At present, Armenia is producing more than 40 models of standard machine tools and approximately 30 types of special machine tools. A number of factories have begun to produce NC machine tools, including the Plant imeni Dzerzhinskiy and the Kirovakan precision machine tool factory. In the 12th Five-Year Plan their manufacture is planned for Leninakan and Charentsavan.

It should be noted that there is a tendency toward rapid growth in the special machine tool sub-branch. This involves three production associations: Almaz, Tekhosnastka and the Charentsavan special machine tool association.

Moreover, we have three enterprises which manufacture general machinebuilding products. These are the Gidropriwod, Stankonormal' and the Charentsavan Tsentrolit production associations.



This is the capability found today in the republic's machine tool branch.

However, it must be said that not all products meet the modern demands of technological progress.

Discarding all manner of objective and subjective reasons, three main causes should be discussed: machinebuilding plants have not reached optimal development of the level of technology, competitive design and organization of production.

IN THE REPUBLIC'S PLANTS, 65 PERCENT OF THE EQUIPMENT HAS BEEN IN USE FOR 10 TO 20 YEARS. THE AGE OF THE METAL CUTTING EQUIPMENT IS ALARMING. SOME 38 PERCENT OF SUCH EQUIPMENT AT THE YEREVAN MILLING MACHINE PLANT AND 20 PERCENT AT THE CHARENTSAVAN MACHINE TOOL FACTORY IS MORE THAN 20 YEARS OLD.

MACHINING CENTERS, AUTOMATED SECTIONS, TECHNOLOGICAL MODULES AND ROBOTS WERE NOT INTRODUCED INTO PRODUCTION DURING THE 11th FIVE-YEAR PLAN. ONLY APPROXIMATELY 80 PERCENT OF THE NC MACHINE TOOLS IN THE ENTERPRISES ARE BEING USED, WITH AN AVERAGE LOAD COEFFICIENT OF 0.65, WHICH IS INTOLERABLE FOR THIS HIGHLY PRODUCTIVE EQUIPMENT.

Some people believe that NC machine tools or machining centers are costly to support and their operation and maintenance are very difficult. I would like to object to this based on the example of the Charentsavan special machine tool production association. NC machine tools have been in use there for some 14 years. The technological problem has been solved comprehensively using modern equipment. A special service and a composite brigade have been organized there, consisting of engineering and technical personnel, mechanics and electricians, to maintain and introduce modern equipment. It would be worthwhile to become acquainted with and imitate the experience of this plant.

THE REPUBLIC'S MACHINE TOOL ENTERPRISES MUST BE RETOOLED (I have in mind basic production) BASED ONLY ON NC MACHINE TOOLS, MACHINING CENTERS AND FLEXIBLE TECHNOLOGICAL MODULES. This doubly improves return on investment: on the one hand the cost of fixed capital is reduced and, on the other hand, product output is increased. Moreover, machine tool workers (who are becoming ever fewer in number) receive the higher social status of a modern NC machine tool operator and their subjective influence on quality ceases being so important in the self-controlled systems found with modern machine tools. This is what technical progress consists of, and enterprise technical services must already be prepared to accomplish it today.

In the republic's plants within Minstankoprom [Ministry of the Machine Tool Industry], it is planned that 40 percent of capital investments for the 12th Five-Year Plan will be for acquiring equipment. However, analysis of equipment modernization plans for 1986-1987 does not indicate that they are directed at fundamental changes in the nature of production -- the creation of flexible, mobile production which is able to modernize product output without substantial capital expenditures.

This is a matter of creating flexible technological processes -- conditions permitting shifting quickly and at the right time to output of new, more modern products, necessarily taking into account the time factor in today's rates of development of science and technology.

By not taking cognizance of the time factor we arrived at drawn out time periods for assimilating series production, which eliminated a number of enterprises from modern scientific and technological machinebuilding developmental trends. Here the urgent problem of competitiveness comes up again.

Many prestigious foreign firms continue to manufacture universal lathes which compete successfully in their foreign markets. THEIR COMPETITIVENESS IS DETERMINED NOT ONLY BY THEIR QUALITY AND TECHNICAL CHARACTERISTICS, BUT ALSO (AND THIS IS VERY IMPORTANT TODAY) BY THE AVAILABILITY OF ACCESSORIES.

In worldwide machine tool manufacturing practice, the cost of all accessories of a machine tool comprises approximately 60 percent of its price. In our republic this index is one-tenth that. "It is important to shift to unitized delivery of equipment," it was stated at the June CPSU Central Committee conference on scientific and technological progress.

IT WOULD BE SOUND PRACTICE UNDER ARMENIAN CONDITIONS to solve this problem BY TAKING ADVANTAGE OF THE SPECIALIZATION OF THE TEKHOHNASTKA PRODUCTION ASSOCIATION, THE CHARENTSAVAN SPECIAL MACHINE TOOL PRODUCTION ASSOCIATION AND THE AFFILIATES OF MACHINE TOOL MANUFACTURING ASSOCIATIONS, AS WELL AS THE ARMIIMash TECHNOLOGICAL INSTITUTE AND THE ARMSTANOK SCIENTIFIC PRODUCTION ASSOCIATION, WITH ITS EXPERIMENTAL PLANT. SUCH AN ORGANIZATION OF PRODUCTION WILL CREATE, IN ADDITION TO THE AFOREMENTIONED, GOOD PRECONDITIONS FOR INTERFACTORY COOPERATION AND CONCENTRATION OF PRODUCTION.

A well-made universal lathe with a full set of accessories and high technical specifications not only will be competitive, but is also something which has been needed by the domestic metalworking industry for many years.

Output of universal lathes in no way excludes such an important task as manufacturing NC machine tools, technological modules or machining centers.

While mastering and manufacturing new generation machine tools, enterprises are being supplied with advanced equipment and technology, cadre professionalism is improving, the social nature of production is changing, the time factor is being taken into account and the need for ever newer technical solutions is increasing. For example, at the Charentsavan special machine tool production association it became necessary to put together control programs. A Nairi-2 computer was acquired, but it soon was unable to satisfy the growing needs of production: It was already necessary to control it. Minstankoprom provided a YeS-1022 computer to meet this need. The tasks expanded and then the requirements. The VTs [computer center] collective which had been created developed and introduced an ASU-TP [automated system for the control of technological processes]. During a shift the computer issues to production more than 200 routes with sketches of billets and parts; control programs; calculations for machining complex designs; etc. Thus, the

computer center became the "lungs" of a complex organism for the control and organization of production.

One of the successes of the Moscow Krasnyy Proletariy association is the fact that it manufactures subassemblies for its machine tools in its specialized machine tool affiliates. It is becoming obvious that under conditions of one republic this problem can and must be solved more effectively either in affiliates or in one of the factories, by having it specialize in manufacturing this product.

By using flexible systems it is possible to shift quickly from design of one subassembly to a more modern one and, correspondingly, for the main plant to shift from one range of machine tools to another.

Based on two NC machine tools developed by the Zakavkazskiy Affiliate of ENI MC [Experimental Scientific Research Institute of Metal-Cutting Machine Tools] of the Armstanok scientific production association, and assimilated by the Plant imeni Dzerzhinskiy, a qualitatively new machine tool attachment (for lathes and centering and cutting machine tools) was developed by this institute. Thus, the flexible module most used in billet milling operations was created, which is to be manufactured at this same factory. Flexible systems for various technological ranges required for production can be put together based on machine tools produced in the republic. In the future this task can be accomplished by the ENIMS Zakavkazskiy Affiliate and its experimental factory.

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### KRASNY PROLETARIYAT TO MAKE NEW GENERATION MACHINE TOOLS

Moscow Domestic Service in Russian 1900 GMT 10 Nov 85

[Summary] A new production block has come into use at the Moscow Krasny Proletariyat Machine-tool Association, Sergey Omelchenko reports. During this 5-year period, the association has been the first in the country to master serial production of numerical control machine-tools and has had a branch added in Cheremushki, the site of the new block. One of the new workshops is temperature-controlled. Production of unique, high-precision machine-tools has begun and capacity is increasing. Nearby is a shop where industrial robot-manipulators are being built.

The association is the first in the country to begin serial production of robots. Two types of robots are being assembled, some small with two arms and grippers, others one-armed. With them, metal cutting machine-tools become fully automatic. These robots are part of flexible manufacturing systems run by computer. This year 1,000 robots have already been produced.

Yuriy Ivanovich Kirillov, the deputy chief engineer, reports that the accelerated output of progressive equipment for the technical reequipment of machine-building is planned. The output of super high-precision machine-tools is to be considerably increased. The production of automated and robot equipped complexes is also to be increased. The association's Cheremushki branch produces 12-15 industrial robots a day. The association has pledged to produce, from the beginning of 1986, 600 industrial robots by the opening of the party congress. At the same time, the machine-tool builders await more advanced, more reliable numerical control systems.

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### VORONEZH HEAVY PRESS BUILDER STARTS SERIES PRODUCTION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Oct 84 p 2

[Article by G. Palamarchuk, machinebuilding department manager, Voronezh party obkom: "In Competition for USSR State Prize: Giant Presses"]

[Text] The team at the Voronezh Production Association for the Manufacture of Heavy-Duty Power Presses was confronted with an important task--to develop and master in series production in a short space of time almost 90 models of new press equipment, to satisfy the demand of the principal customers in our country for it, and to go out into the international market. Solving this problem required great efforts on the part of the association's workers, engineers and specialists.

Now it can be summed up: The Voronezh machine builders successfully coped with the assignment and the country has gotten high-power mechanical presses of a high technical level.

The heavy-duty and unique press equipment with the "TMP" emblem can be encountered in many machinebuilding enterprises. And from 50 to 150 machines are in operation at such giants as the Kamo and Gorky automobile associations, ZIL [Plant imeni V.I. Lenin] and BelAZ [Belorussian Automobile Plant], Gomsel'mash [Gomel Agricultural Machinebuilding Plant] and Rostsel'mash [Rostov Agricultural Machinebuilding Plant]. These products are known in 42 countries of the world.

Of course, the development in a short space of time of an extensive list of lines, systems and high-efficiency presses (and the number of new models of machines is almost 100 at the present time) required intense scientific quests and research. The theoretical principles of the design and calculation of the heavy-duty and unique presses developed by the plant's specialists in conjunction with associates of scientific research and educational institutes were verified experimentally, and were then confirmed by longterm experience in using the machines. They revealed the possibility of increasing the productivity of large presses by a factor of 1.6 to 2.8, of developing highly mechanized lines of equipment with standardization levels of up to 56 to 87 percent, of reducing the specific metal content of heavy-duty machines by 10 to 15 percent, and of improving other technical parameters.

The creators of the new forging press equipment have 95 patents to their credit.

A very powerful press has been developed at the association which develops a force of 6300 tons; it weighs 1100 tons and is designed for forming parts up to 12 meters long, i.e., those without which it is impossible to produce heavy-duty trucks. It is true that similar presses exist. But the new "hero" is distinguished from its counterparts by higher productivity--by a factor of 1.5 to 1.6--and higher forming precision--by 30 to 35 percent--and it weighs 420 tons less.

The annual saving from the introduction of the new press equipment into the national economy is 15 million to 20 million rubles.

The work done by the Voronezh press builders, in which the teams of the Moscow Machine Tool and Tool Institute, the Kamo Association for the Production of Heavy-Duty Trucks, and the All-Union Scientific Research Institute of Metallurgical Machine Building took an active part, in our opinion has been justly nominated for the competition for the 1984 USSR State Prize.

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC: 658.310.33:[658.3-057.21:621.941.28.529

### MULTI-MACHINE SERVICING OF PROGRAM CONTROLLED TURRET LATHES

Moscow MASHINOSTROITEL in Russian No 1, Jan 85 pp 36-37

MAKAROVA, I.V., Engineer

[Abstract] In order to determine the reasons for significant nonproductive expenditures of working time by the operators of program-controlled turret lathes, an analysis of their activity during a working shift was performed. Studies included full photographic chronometric studies at two plants, selective time and motion studies at a third. Analysis showed that the significant variation in time expended in installation, adjustment and removal of large parts on the machines was related to the need to adjust the position of the part on the surface plate, a process which is particularly lengthy if the relative position of the part surface worked in the previous and present operations must be adjusted. The greatest amount of secondary time is that spent in adjustment of assembled sections and installation of parts with worked surfaces of identical size. Time spent in installation and adjustment of parts increases toward the end of the shift. The major factor requiring operators attention is the accumulation of chips on the surfaces being worked. Automation of chip removal would reduce the number of times workers must approach the machines. Servicing of multiple machines requires higher level of organization and servicing of working locations. Workers must frequently stop working before the end of the shift, in order to pass the machine along to the next shift without a part in process of being worked on the machine at the transition. Organization of work so that the machine need not be clear at shift change would increase the productivity of labor.

[142-6508]

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## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

### NEW DEVELOPMENTS IN CAD, FLEXIBLE MANUFACTURING

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 9, Sep 84 pp 4-6

[Article by N. Margolin, sector manager, scientific secretary of the council scientific and technical division of the Minsk Automated Lines Special Design Bureau and V. Tarasevich: "Union of Science and Industry: Flexible Complex"]

[Text] The Minsk Association for the Production of Automated Lines imeni 60th Anniversary of Great October has always attracted the attention of automation specialists. However, in this case, the attention has not been drawn to the association's production but to its automated lines and machinery. The automation of the association's own individual production has drawn the interest not only of specialists but also of students, educators and persons of different professions. Entire delegations come to see the flexible production system in action.

Flexible production systems and computer-aided design are often spoken of separately but should be the connection between automating the work of the designer and that of the machine operator? However, we will not forget that this is only one link in the entire chain started by the design process. Many years ago, everything began with machine design, the mastery of which was worked on by a group of enthusiasts in the Minsk Special Design Bureau for Automated Lines. The work was conducted stubbornly and consistently and its result was the presently operating flexible complex which is the single system that will eventually be able to execute all technological processes.

Let us begin with computer-aided design.

The sector manager Valery Mikhaylovich Markov attached to a Kuhlmann drafting unit the layout for a spindle box. It is no simple thing to immediately discern the basic units from the fabric of direct and axial circles and it is still harder to arrange them so that no one will "disturb" another. Every designer must inevitably face the task of spatial compatibility.



"Even an experienced designer loses many hours and days on such tasks and still makes mistakes often enough," said V. Markov. "Meanwhile, a computer can do the same work with no errors in a few minutes. It is understood that this is just a small amount of everything that we do with computers".

At first, the computer-aided design system in the special design bureau was used to calculate coordinates and later grew into a design system. Designers, scientists and engineers became involved in teaching the computer how to work. Their enthusiasm did not come from out of thin air. The key to automation was standardized parts and components. In the design bureau and plant, a constant effort was made to use known and tried parts and components in the new designs. For example, about 98 percent of the parts in the spindle box are standardized. Their entire array consists of more than 450 items and 2500 designs and standard sizes. With such a reliable base available, it was then possible to begin standardizing designs. However, unification was not in the first stages so encompassing but it was extensive enough for the first experiments. Help was provided by specialists from the computer center of the Belorussian State University and scientists from the Institute of Technical Cybernetics of the Belorussian Academy of Sciences. Nevertheless, the initiators and pioneers were the designers themselves: Division Manager E. Tukayev and section managers S. Gindin, V. Markov, M. Zisko. Familiar with all of the details of design work, they studied the possibilities of computer technology and programming bases. As the result of the painstaking work of the enthusiasts, the computer provided the first data tables which were then used to design the spindle box, the most complicated component in aggregate machines and automated lines.

The computer is now used to perform geometrical and kinematic calculations. It determines the coordinates of all spindles and shafts and checks the spatial compatibility of the subcomponents and parts. As we have already mentioned, the designer alone is practically unable to carry out so many calculations any more than selectively. The remaining parameters of the component are set on the basis of its intuition and experience and this does not exclude the possibility for mistakes to occur. To use the words of the designer, the computer "considers" everything and selects the best variant. It prints out technical documentation in the form of tables that have replaced traditional blueprints. When necessary, the "smart" and accurate automatic graphic plotter can produce blueprints.

Based on the experience of using a computer in the development of spindle boxes, the design bureau has created a special division for comprehensive automation of design work. It is there that designers take assignments for calculations or designs which look like questionnaires. They sign into a journal and the operator then takes over the work. With the aid of a data-preparation device, he converts the task of the designer into machine carriers. These are then entered into the computer which uses a given program to design or calculate. The results provided on magnetic tapes or perforated cards results "animated" in the design bureau's computer room. With the help of automated equipment, they are transformed into textual and graphic documents, the final product of the computer-aided design system. At the same time, another step toward a flexible complex is made here. The same spindle

boxes do not only turn out the design documentation but also a perforated tape of the control programs for the NC machines. This system is called Avtopriz and it was successfully demonstrated at the "Metal-Working '84" international exhibition.

Describing how the computer-aided design system "works" at the association, a section manager, Candidate of Technical Sciences V. Ozersky repeatedly pointed out that all of this has long ceased to be a novelty and must be further developed. It is true that sometimes the computer time is not enough because the association's computer center is overloaded. We cannot waste the computer capabilities the way other plants are doing. Even with the addition of an SM [not further identified] machine, all of the existing programs will still inevitably have to be redone. The association is impatiently waiting for this moment because they are counting on computer help to drastically reduce the labor-intensiveness of design work.

To put it more simply, with the constant increase in the volume and complexity of design work, the number of designers should remain the same or grow only slightly. The goal for this five-year period is to broaden the scope of design work conducted with the help of computers. We must say at this point just what processes it is that we have in mind and above all, it is noncreative, routine work that is subject to formal logic. Analysis done by the design bureau has shown that the intellect of a designer is an irreplaceable commodity in reaching a fundamental technical decision or in preparing blueprints, etc. However, in most of the work, such jobs take up only a small amount of time. Most of the work involves searching for necessary data, performing engineering calculations or making blueprints, preparing technical documentation or monitoring processes. This is where the computer can and should be helpful. It gives the designer more time to be creative and takes upon itself the draft work which it performs without mistakes.

The most important segments in design preparation for production where computer-aided design systems have been introduced are designing spindle boxes, conductor plates and hydraulic equipment, synthesizing and drawing the principal hydraulic scheme and preparing the design documentation on electrical equipment. Packages of programs for engineering and economic calculations have been introduced and put into use. These determine the geometric and strength parameters of cylindrical and conical gear trains, set coordinates on a plane, determine the economic efficiency of equipment and calculate the indicators for reliability and productivity, etc.

Work on the creation and introduction of a system of computer-aided design of technological processes for machine working is being carried out by association specialists along with scientists of the Institute of Technical Cybernetics of the Belorussian Academy of Sciences. Four packages of programs have been introduced for gears, bushings, body parts of spindle boxes, shafts and spindles. The system automatically prepares a routing schedule, calculates the number of form of blanks needed, sets dimensions and tolerances, selects a machine model and all necessary tools and calculates the time norms for machining. The computer-aided design of technological processes

has made it possible to automatically design thousands of individual technological processes in a year. As a result, the productivity of engineers and technicians was increased slightly while the labor-intensiveness of developing technological processes was reduced.

Large-scale automation of structural and technological design is a complex, painstaking matter requiring the coordination of the efforts of various organizations within the association. The specialists of the design bureau and the plant have convinced themselves of this. This is above all a matter of creating software for general use and developing so-called invariant programs. Now every organization of even two neighboring plants must deal with this individually. This holds up the development of computer-aided design systems and the exchange of experiences. It also dissipates resources and increases the amount of labor and time spent handling such problems. Meanwhile, according to specialists, no less than 75 percent of overall work goes into the development of working programs.

A serious hindrance to the greater introduction of computer-aided design is the lack of peripheral equipment for computer technology. Last year, the association's designers made substantial additions to their arsenal. In the machine room of the special design bureau, a modern graphic plotter and an ES7970 display were added. These made it possible to begin work on a dialogue system for computer-aided design but they were not enough.

What does the future hold for computer-aided design? First of all, the functional capabilities of existing design subsystems will be expanded. The goal here is to more fully cover the parts list of created equipment and to even further reduce the labor-intensiveness of design work. Second, new subsystems for the introduction of machine methods in the basic machine divisions of the special design bureau will be developed. From a point of view of automation, this is an especially complex problem because formal logic is least applicable to the work done here. Still another important direction is systematizing and standardizing the solutions used in designing attachments and accessories. The question of using the results of computer computation of machinetechnological parameters to automate the development of general forms of equipment has become the problem of the day.

The introduction of computer technology to the design bureau in combination with an automated control system forms the basis for realization of a flexible production system. In the Minsk Association for Production of Automated Lines, the idea has already attained real lines. For a long time, one of the bottlenecks at the P.M. Masherov Plant was the shop producing parts such as plates, bars and levers of complex configuration. They make up 44 percent of the total parts list produced by this shop. About 35 percent of the labor in this same shop goes into making these items. The development of such parts requires frequent machine setting and it was therefore found that NC machines would be more feasible for these operations. Actually, any operation requires some lost minutes but machine adjustment takes an hour and a half. As they say, the idea of building a flexible production system was far away. It was necessary to make the first step, the first new horizons in automation to be discovered in the industry. At first, they measured everything 7 times:



they used a computer to calculate whether it would be feasible to introduce an adjustable line. It was found that 40-45 percent of all parts could be produced on automated lines.

All components and machines of a flexible production system should have a reciprocal link with the control computer. The computer can provide automatic loading and machining of parts of any configuration, in any order and with any program. Aside from this, it provides the necessary information on the performance of the system and the starting data used for planning the next shift and diagnoses the work of the machinery. At the present, it is doing all of these things. However, when a flexible production system has just been created, its "brain", the control computer, exists as a thing in itself and an automated line would be without it nothing new. The association turned to the leading industrial institutes for help but was turned down. There was nothing else to do but set up the system themselves. The electronics engineers V. Playko and R. Smychkovich worked with other specialists to reach their goal of connecting the computer to a complex. In developing the control systems for separate machines, the association's engineers worked hand in hand with colleagues from the production association of the Leningrad Electrical Machinery Plant.

The flexible production system was not created by engineers alone. A contribution was also made by tool setters like the leading metal worker R. Rubinichenko, M. Pozneris, O. Koplyakov and A. Manulik. At the Leningrad Electrical Machinery Plant, there are many highly-qualified specialists that work with the most complex machinery. It could be said that the above persons are workers with the minds of engineers and it is felt that this is no exaggeration. Many improvements and corrections were made to embody the design in metal form. Without these, the system would not have become so reliable and productive. Enthusiasm is a most accurate word to describe the mood of the creators of the adjustable automated line. Even today the search continues and individual components are improved. Much initiative in this has been shown by Senior Technical Engineer A. Rogotsev, Senior Electronic Engineers P. Kuznetsov and Technical Engineer M. Kupriyanchik.

The advantages of flexible production systems would form a long list. For example, there are 6 different planes involved in the machining of parts of average complexity. Using a universal lathe, a miller or borer must turn the blank over 6 times but flexible production systems need do this only twice. The adjustable complex has sharply reduced the number of steps from blank to finished part. Machining aggregates can mill, drill, thread, bore and grind. They possess a whole series of outstanding features that intensify cutting operations with continuously changing production. Let us look at the chief ones. The tool length is automatically measured with a contact mechanism. The two-stage tool magazine has a high volume while the rotary tables have fixed division with low discretion.

Through the control panel and indicator board, the operator exchanges with the control computer data on the loading and discharge of parts. The reloading of "satellites" into working positions and back is done by 6 manipulators that together with the positions form a production cell or



module. All of these features were developed at the Automated Lines Special Design Bureau.

It must be pointed out here that the development of such a flexible production system was first done by our branch of industry. This required much inventiveness and imagination for the designers to find the most effective way to automate rather complicated technological processes. All of these qualities were demonstrated in full by colleagues of the design bureau's prospective designs division which did most of the work.

Both in the design and manufacture of machines and automated lines, the association's leading principle is to produce modern equipment by the most modern means and methods.

The flexible production system has replaced 20 universal lathes and 40 machine operators and has saved the association 100,000 rubles.

According to the deputy chief engineer of the association, G. Sviridenko, "Flexible production systems form a high order of automated control systems. In introducing them, we had to think hard about how to improve our organization of production. We set our planning system and tool supply into order and very precisely prepare our control programs. The requirements on technological discipline and blank production were substantially increased. A flexible adjustable complex leaves no time for jumps: smooth work and neatness are required. In other words, it requires faster and more precise work.

It is understood that the flexible production system is still improving and broadening its capabilities. Here is a concrete example. To load the system, 70 control programs must be prepared every day. This is done with the help of a computer, trouble still occurs. Instead of the operative memory, the specialists that operate the complex decided to use a constant memory to control the machinery. Leningrad has already turned out "posts" of a new series that make this possible. The control systems will then be loaded just once, at the start of the shift. This considerably simplifies equipment maintenance and saves time. However, not everything is settled by the designers. A flexible system can work well only when all of its components are reliable. This is something that must be considered by the plants that manufacture them.

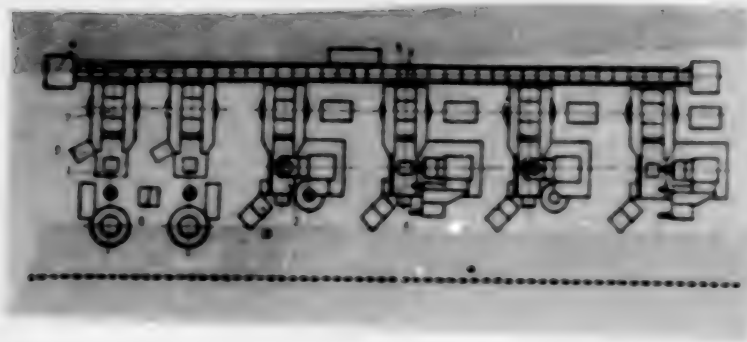
The Minsk Association does not exaggerate its achievements. Everything that has been done here to automate engineering work and production is seen as a basis for further growth. Without waiting for orders or directives from above, they have succeeded in creating a good enterprise, gaining experience in continuous automation which should encompass all levels and penetrate the entire cycle of production from the chief designer to every work place.



Flow chart for automated design and manufacture of spindle boxes:  
 1. starting design data; 2. design of a kinematic layout; 3. automatic blueprinter; 4. control program for NC machine; 5. design documentation; 6. NC machine; 7. blank and part; 8. automated system for production control.



LM700 multipurpose flexible production system used at the Minsk Automated Lines Factory imeni P.M. Masherov.



Layout of a flexible production system: 1. operator stand; 2. "satellite" attachment; 3. machining aggregate with vertical spindle; 4. machining aggregate with horizontal spindle; 5. transport device; 6. side container; 7. reloader; 8. operator's control panel; 9. indicator panel; 10. NC device.

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INTEGRATION OF ACTUAL FMS COMPONENTS DISCUSSED

Moscow MASHINOSTROITEL in Russian No 6, Jun 85 pp 30-33

[Article by Ye. N. Maslov, Doctor of Technical Sciences and Professor: "The Plant of the Future Is Being Born Today"]

[Text] Our country's machinebuilding is one of the world's leaders in volume and range of products produced, and it is a continuously and rapidly developing branch of industry that supports to a great extent the progress of the country's whole economy.

What will the machinebuilding plant of tomorrow be like? The complexity of the answer to the question posed derives from the multifaceted nature of machinebuilding, which manufactures a vast diversity of machines (diverse as to purpose, size, complexity, precision, and so on) at plants with various kinds of operation (single-item, series and mass production), with diverse equipment, technologies, level of mechanization and automation of production processes, organization and management of production, and so on. But nevertheless, this question can be answered unambiguously: the machinebuilding plant of the not-so-distant future will possess such characteristic features as deep specialization by item and by technology, highly productive equipment and advanced technology, effective production organization and progressive methods for managing production.

The wide use of major achievements of basic research in the areas of physics, chemistry, electronics, mechanics and other scientific areas will be manifest in new and vigorous progress in developing machinebuilding. For example, the rapid development of high-pressure physics has, up to the present, enabled a large group of new materials with special properties (superhard, superstrong, heat-resistant, highly magnetic, and so on) to be created. The superhard-materials group (based upon synthetic diamonds, boron-nitride cube and compositions thereof) have been accorded special importance in the manufacturing of various cutting tools which possess high hardness and allow effective operation of flexible automated systems. The development of powder metallurgy has been the basis for low-waste and waste-free manufacture of parts. The use of modern high-powered laser equipment has enabled the effectiveness of many industrial operations to be raised, such as, for example, the machining of articles made from superhard materials, the heat treatment of metals, and so on.

Basic research in various areas of chemistry has paved the way for plants to use new electrochemical processes, high chemical energies, corrosion-resistant coatings, effective means for lubricating and cooling, and so on.



The vigorous development of electronics has enabled the creation and introduction of compact minicomputers for high-speed integrated systems which, in conjunction with mathematical methods, have opened up unprecedented prospects for solving practically any scientific and technical tasks, including those in the area of automating the design of new machines and the development of progressive industrial processes. With wide introduction of the results of theoretical and experimental research in the area of the mechanics of continuous media (yield and creep of metals), great progress has now been achieved in the working of metals with pressure (extrusion, stamping, and so on). Improvement of methods for producing blanks by precision stamping, rolling, casting and welding and the introduction of special curved shapes will permit the metal-utilization coefficient to be increased up to 85 or even 90 percent during mass production.

Scientific and technical progress has already, up to now, promoted a great renewal of our country's machinebuilding: the technology and equipment that accomplished it have been improved intensively, primarily in the mechanization and automation of those industrial processes that mainly determine the level of productivity of all the means and implements of labor. This improvement rises sharply in the conversion from single-unit production to series and mass production.

A major scientific and technical program for further qualitative improvement in machinebuilding by creating highly productive flexible manufacturing systems (GPS's), which permit conversion to the output of articles of a different range of products or of new (or improved) design in a comparatively short time and at little expense, is being realized in our country. Flexible production, which is more productive in series production, can also be effective in single-unit and mass production. In single-unit production, GPS use will be effective if grouped machining technology is fully used. In mass production, with the introduction of GPS, conversion to the production of new (or improved) machines will not be hampered by the so-called "rigid," that is, nonresettable (synchronous) system of automated lines and production sections that are used in the type of production being examined. By virtue of this, flexible manufacturing systems will occupy a leading position in the machinebuilding industry. It will permit many machines that are mass-produced to be improved quickly, systematically and effectively, and this, in the final analysis, will considerably speed up scientific progress in machinebuilding.

Automated rotary and rotary-conveyor lines, which are characterized by continuity of industrial processes and which enable a sharp rise in industrial production intensification, including machinebuilding production, the machining of materials by cutting and stamping, the manufacture of parts made from plastics and powders, foundry production, and so on, will also be greatly developed in the next few years.

Machine-toolmaking will send customers not only single industrial aggregates but also, chiefly, automated complexes for producing definite parts. NC-type industrial equipment, industrial robots (adaptive, remote and others) and computer control will be improved on the basis of microcomputers, and the result of this will be further growth of production lines, sections, departments and plants (especially for series production), with integrated automation based upon GPS. Scientific developments will be aimed at creating a

unified ganged-module system for constructing NC-type industrial aggregates with PR's [industrial robots], which have a high level of automation and economic effectiveness.

The PAS-type MA-1 flexible automatic line with replaceable multiple-spindle units can be an example. It is equipped with NC units and industrial robots and was designed for machining holes in box-type parts with a rod-type tool (drill, countersink, reamer and so on) in series production. The line will allow various units to be outfitted with tools (the total number of tools is 298). A feature of this flexible line is the potential for stationary use and for transporting multiple-spindle tool units to the power pack during the whole time the part is being machined.

Industrial aggregates that will be widely used in the not-so-distant future should also include installations with NC and PR's with so-called "artificial intelligence," that is, with a technical system capable of discerning a changing situation and of automatically choosing a solution for its further actions in accordance with the industrial task assigned. Combination computer processing of visual and tactile information will enable various practical tasks of great importance to be solved, such as, for example, during automated assembly of machine members.

Specialization of enterprises by part and by article will enable the creation of mass production and large-series production with progressive technology and the wide use of flexible automated lines, ganged tools and special tooling, and with comprehensive automation of production systems and departments, which will provide for stable output that is high in quality and low in cost.

In single-unit production, during the manufacture of experimental and single-item equipment, industrial machines with wide automation of auxiliary motions (charging, releasing, control, monitoring and so on) will be used. In single-unit and small-series production, computer-controlled grouped machining of parts and the use of unified technological multiple-use tooling (USP [universal assembly devices]), and so on are proposed. The establishment of overall standardization of industrial processes within machinebuilding, taking the specifics of the machinebuilding branches into account, is being basically completed.

Multiple-spindle and multiple-tool machining of parts with high continuity of the process and the use of highly productive multiple-edge cutting tools will find wide application. The tools will be equipped with cutting members made of the newest superhard materials (based on boron nitride cube, synthetic diamonds, cermets, and so on), which help to raise cutting speed and the productivity and quality of machining.

The industrial tooling of enterprises will be improved, thanks particularly to the replacement at plants of obsolete means and implements of production by equipment that is more effective and productive, has a high level of mechanization, and is convenient to operate, taking into account the possibility of using it with GPS.

The level of mechanization and automation of transport within plants, and also of storing the loads carried (parts, attachments, tools, and so on),

will be greatly raised. At all enterprises that are large enough, storages with internal routing will operate (including computer-controlled storages) with unified stacking cranes and shelving and with standard production packaging with automated and semiautomated modes for outfitting, storage, search for and dispatch of loads. Such storages with integrated mechanization will be an organizing element in the control of the whole production cycle--from the arrival of materials to assembly of the product. PR's will be used quite widely for mechanizing, loading, unloading and various labor-intensive operations.

Sizing methods for machining parts, which determine to a great extent the quality, reliability and longevity of machines, will be highly developed. The production of machine tools for electrophysical and electrochemical machining methods will grow substantially. In many cases, processes that combine cutting with various electrophysical and electrochemical methods of dimensional machining will come to replace ordinary machining methods in many cases.

Even now a number of mass-production enterprises are being rebuilt for the purpose of creating modern highly automated flexible production facilities (for example, the Motor-Vehicle Plant imeni Leninskiy Komsomol and the Machine-Toolmaking PO [Production Association] Krasnyy Proletariy).

Here are some examples of modern domestic and foreign flexible automated manufacturing facilities that are being developed continuously and intensively in the areas of flexibility, comprehensive mechanization and high effectiveness and which, therefore, are characteristic of machinebuilding plants of the not-so-distant future.

Type ASV-20, ASV-21, ASV-22 and Other Flexible Automated Sections, which were created by the NPO [Science and Production Association] ENIMS [Experimental Scientific-Research Institute for Metal-Cutting Machines] (Moscow) with the participation of other NII's [scientific-research institutes] and plants, which were designed for machining mainly bodies of rotation during computer-controlled small-series and full series production. Forgings, castings, rolled metal and so on can be used as blanks for the parts being machined. The section's main subunits are the production, transport and control subunits.

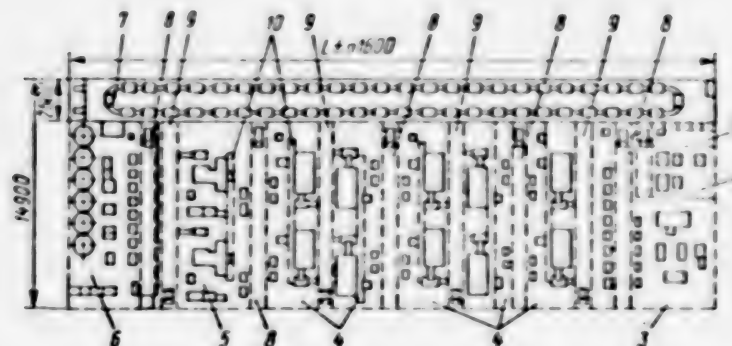
A production subunit of an ASV-20 section consists of 10 NC machine tools (8 turning and 2 boring-and-milling type machining centers), which are installed in sections 4 and 5 (figure 1) and they also include the sections: 6--for setting up and tool outfitting; 3--for OTK [quality-control section]; 2--shaving and chip collection; 1--power feed; and 9--removal of shavings and chips. The transport subunit has an intermachine transporter 7 and load-lifting manipulator 8 installed in zone 10. The computer-control subunit was built for current-production planning and accounting, based upon M6000 and SMI type computers. Operation of the section under full load will support a 1.4-fold to 1.7-fold rise in productivity of machining products, in comparison with individually used NC machine tools.

The Talka-500 Flexible Automated Section of the Ivanovo Machine-Toolmaking PO imeni 50-letiya SSSR is intended for machining framework parts during computer-controlled small-series and full-series production.



Figure 1.

[See text on preceding page for keys.]

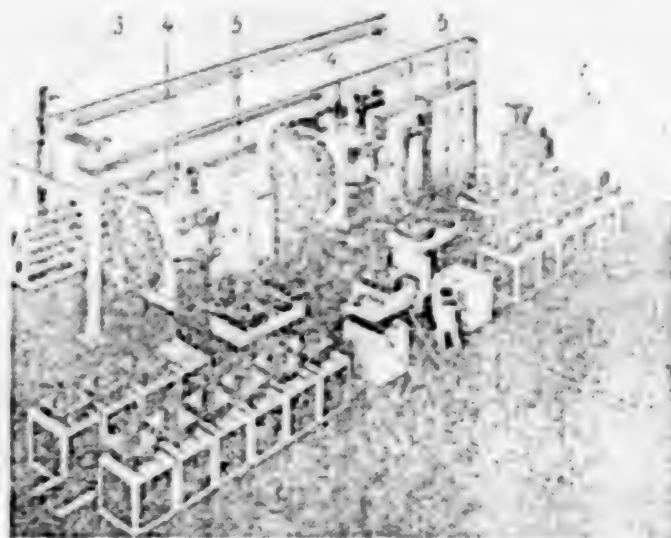


A production subunit of a section consists of NC metal-cutting machine tools: an IR800 module, an IR800 block-center module and an IR500 globe-center module, as well as the serving arrangements. The transport subunit, which connects the machine tools with the serving arrangements, consists of a robot cart and its electrical controls and rails. The robot cart can be replaced by a rail-free cart with inductive control (a robot roller). The automated storage with stacker crane receives for storage and sends out blanks, cradles, parts, tools and other articles. At the loading station the blanks are installed in a definite position in the cradle and are sent to the machine tools or to the accumulator. Control is two-level. The upper level includes a specialized SM-2 type computer-based system with a device that stores, transships and exchanges information with the lower level devices. The lower level includes devices for controlling CNC-type NC machine tools and also the transport subunit, automated storage and auxiliary devices.

Figure 2.

[See accompanying text for keys.]

Figure 2 shows a flexible automated production facility--a TS-630 section (Fritz Varner, West Berlin) for machining various framework parts 1. The production subunit includes two NC machine tools 4 for a machining center with electrical equipment 5, a gantry robot 3, which serves the tool storage 2, and other devices. Each machine tool has a magazine for 40 cutting tools. Tool replacement time is 4 seconds and spindle-rotation frequency is 20 to 4,500  $\text{min}^{-1}$ . The blank being machined is moved relative to the cutting tool along three coordinate axes.



Prior to machining, each blank is placed on its cradle and moved to the stand 6, and then is automatically installed on the machine tool 4. After machining, the blank is automatically taken from the cradle at the loading and



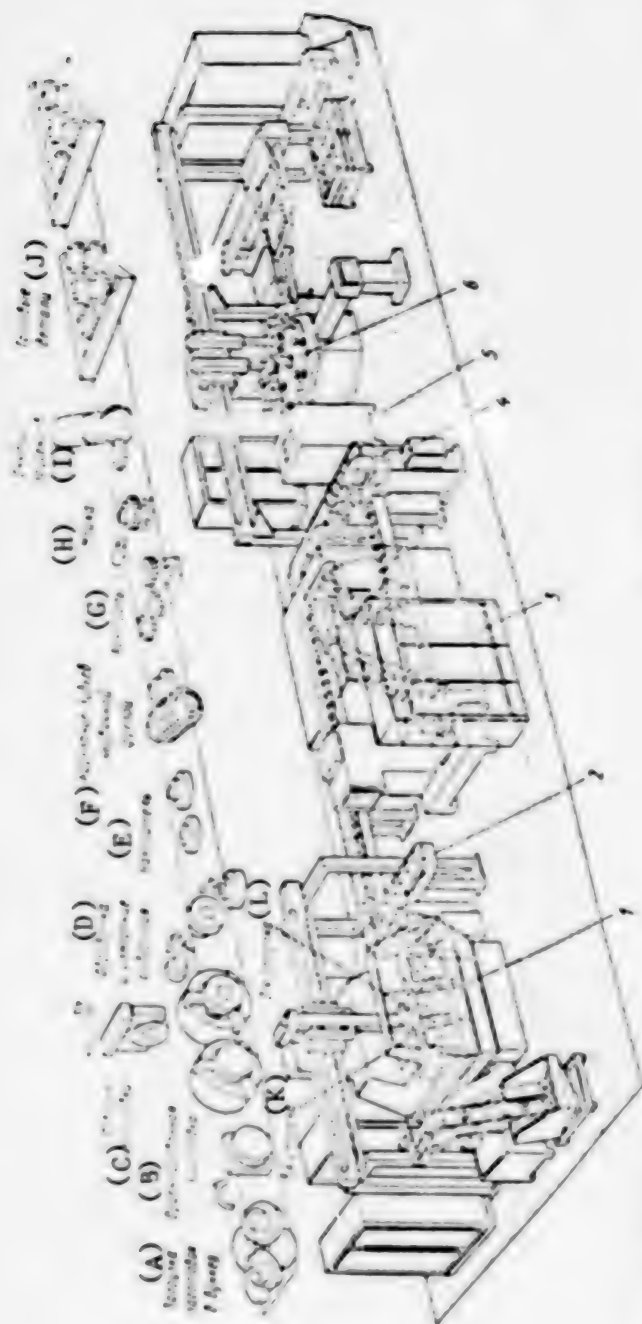


Figure 3.

- A. Loading blanks into the hopper.
- B. Oriented blank.
- C. Turning of the blank.
- D. Machining and measurement of the hole.
- E. Accumulator.
- F. Teeth cutting by a hobbing cutter.
- G. Monitoring.

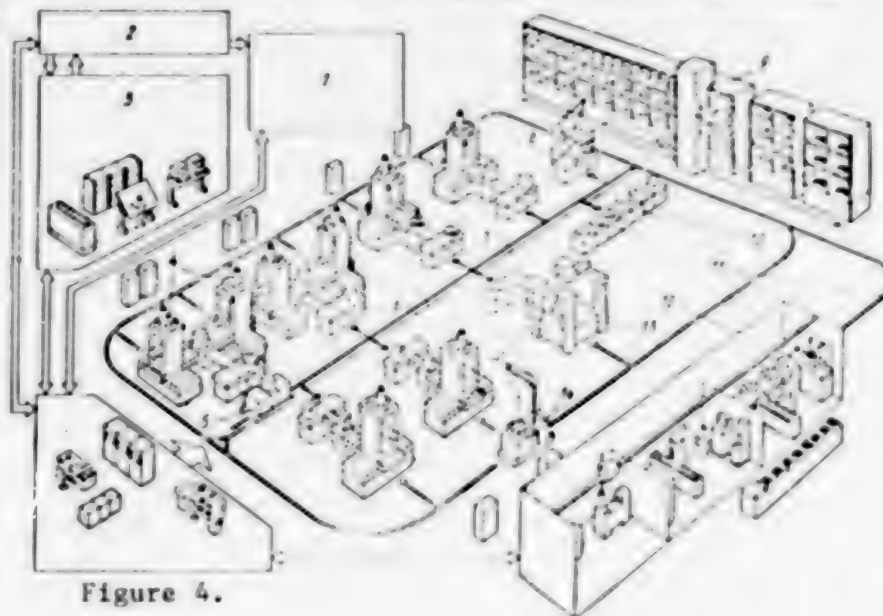
- H. Washing.
- I. Removal of burrs.
- J. Finished parts.
- K. 1st side.
- L. 2d side.

[For numerical key, see text on next page.]

unloading station 7. The blanks and parts are automatically transported from the cradles by robot carts 8. Equipment operation is controlled by video instrument 9, and instrument 10 serves for installing and adjusting the tool. During large-series production, the section can be expanded to four or more machine tools.

The Flexible Automated Production Facility, a line for the mechanical machining of cylindrical pinions (for example, the line of the FRG's G. Pfauter company), has the following types of industrial equipment, which operates in an automated mode: a two-spindle lathing automaton 1 (figure 3), with the blank installed from a hopper, and built-in instrument 2 for measuring the hole; automaton 3 for cutting teeth with a hob cutter; instrument 4 for monitoring the precision of the pinion teeth that have been cut; washing machine 5; and multiple-spindle machine tool 6 for taking off burrs from pinion teeth. The blanks for the pinions are forgings and castings.

The flexible automated production facility of the not-so-distant future will have, in addition to an automated system for controlling industrial processes 1 (figure 4), an automated system for production control 2 (ASUP) and a system for automated design 3 (SAPR). The ASUP includes: scheduling, analysis of shiftwork tasks, and monitoring of plan fulfillment. Such a production facility will have: machining-center type NC machine tools 4, automated storage 9, a section for flexible preparation for production 12, an accumulator with automatic loading 6, a robot cart 5 for transporting blanks



with the cradles, a robot cart 14 for transporting the tool, a measuring machine 13, a loading and unloading station 8, and a buffer accumulator 10. Line 7 indicates the path of movement of robot cart 5, and the peripheral line 11 is the path for robot cart 14. Section control is two-level.

Technological discipline in the enterprise's departments is growing considerably, and this will provide for stable receipt of high-quality output.

The importance of active monitoring means, which will permit the technological processes to be controlled, and of automated means for an objective assessment of quality, including reliability (longevity), of the finished product, is being increased in metrological support of product quality.

Scientific organization of work and of management will enable the industrial process to be constructed more rationally, will provide for high sophistication of the work and precise interaction among the various workers, sections,

and departments, and will create the best sanitary-engineering conditions at enterprises. Work will continue on introduction of the brigade form for organizing work. The qualifications of the blue-collar workers, engineers, and technicians who carry out the preparations for and execute the automated industrial processes will grow, and overall production sophistication will rise.

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## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

### ADVANTAGES OF PHASED IMPLEMENTATION OF FMS EMPHASIZED

Moscow TRUD in Russian 3 Jun 84 p 2

[Article in "Specialist's Opinion" section, by G. Figurov, deputy chief engineer, All-Union Design and Technology Institute of Power Machine Building, and L. Zal'tsman, chief project designer, Leningrad: "On the Way to Automation Plants"]

[Text] In the last decade the attention of scientists and production workers has been attracted more and more by flexible automated production processes (GAP's). They differ considerably from ordinary automatic lines. First, the machine tools, manipulators and transport facilities do not have a strict program here; by means of numerical program control they are easily converted for processing a new product. Secondly, the use of a GAP makes it possible to automate not only processing, but also the entire job cycle. In this case the production process is organized so that it can quickly react to a change in purpose.

This is especially valuable for those 60 to 70 percent of plants and factories of our industry in which small-lot and diversified-range products are produced. It is precisely a GAP which makes it possible for them to improve labor productivity sharply. The latest achievements of science and engineering--computers and computing equipment--are embodied in each flexible automated production process of this type. It is completely natural that the fee for the high-level of performance is accordingly so high. For example, the cost of a unit of equipment included in a GAP for rounded shapes and body parts is estimated at 200,000 to 300,000 rubles.

Almost every machinebuilding enterprise foresees the introduction of one or two GAP's in the very near future. Here, of course, they want to get them right away in the form in which they are shown at exhibitions, i.e., in full array, almost or entirely automatic. In other words, in the most expensive version.

On the other hand, this is not the only way. There exists a less well known but by no means less effective approach to the formation of flexible production processes. It is easy to single out two principal stages in the process of introducing them: industrial engineering preparation, and the direct installation of the latest equipment. This separate implementation of a GAP



makes it possible to make more efficient use of facilities and to gain a considerable saving as early as in the next few years.

Only a high level of automation can make possible the most substantial saving of personnel resources and a 5- to 10-fold increase in labor productivity. But this is the most expensive part of a GAP. On the other hand, even before installing the new automatic machines it is possible to organize the production process in such a way that labor productivity is increased by 50 to 100 percent with the existing equipment. The equipment utilization factor, which usually equals all of 0.3 to 0.4 in diversified-range production, can be increased especially markedly. Maximum-efficient organization of the production process in a GAP makes it possible to reduce to a minimum downtime resulting from the absence of stock, from a non-optimal utilization schedule, from resetting-up losses, etc. The utilization factor increases to 0.7 to 0.8 and, accordingly, production output is increased twofold. It appears that the introduction of an industrial system without shutting down a production process, in operating production equipment, is today the most efficient and realistic way of mastering a GAP.

We can be confronted with the following objection: Such an approach to the formation of flexible production processes does not exist in foreign practice, where GAP's are introduced at once. But nevertheless it seems to us that in this case it is not obligatory to follow foreign know-how. You see, the approximately 100 GAP's developed by firms in various countries are chiefly small ones; they not infrequently consist of a total of 3 to 10 units of equipment. This makes it possible for the owner of a small firm to quickly appear to be ahead of his competitors. You see, his expensive process has extraordinary flexibility and adapts at once to fluctuations in demand. Such a local gain is very advantageous to an individual owner. Such local gains can be of no minor importance also in a number of cases for domestic industry. But the total national economic saving is much more important to us.

Of course, a simplified approach is impermissible here. It is a question not of industrial engineering measures in general, but of the specific system which is capable of "preparing the soil" for a GAP. It includes seven automated subsystems inseparably interconnected and affording a real saving only with their combined use. They are: production engineering preparation of the production process; scheduling; real-time control; monitoring of equipment operation; warehousing; transportation; and the computing subsystem uniting the entire system.

This entire system was introduced successfully in the existing production process at the Dnepropetrovsk Electric Locomotive Building Plant, for example. The innovations cost the enterprise approximately 15,000 rubles per machine tool. But then the machine tool utilization factor increased twofold and a considerable annual saving was gained.

Theory and practice speak for the fact that it is most sensible to divide the formation of flexible production processes into two stages. Here it is advisable to combine the second decisive stage with scheduled re-equipping of

the enterprise, providing for the replacement of key equipment as it wears out or becomes obsolete. But the first stage should be carried out within the next few years.

Let us discuss in an example what this can produce. Let us assume that in an industry in which there are more than 10,000 machine tools in operation it has been decided to spend 100 million rubles for the development of GAP's in the 13th Five-Year Plan period. If flexible production processes are constructed at once, in their entirety, then only 300 machine tools can be made for this money, i.e., a total of three percent of the industry's total inventory. Now, by employing only the first stage in the mastery of GAP's it is possible to cover not less than 3000 machine tools with the same money. The increase in production output and labor productivity is considerably greater in the second case. Let us add that the time it takes to implement the first stage with the presence of the technical facilities (computing hardware, warehouses and transportation) is only 1.5 to 2 years, whereas development of the entire cycle for a GAP requires not less than 5 years.

The advantages of two-stage introduction are especially obvious within the framework of an entire industry. And, for sure, are less noticeable if the operation of a separate small enterprise is analyzed. However, it seems to us that it is precisely the broad perspective, from the viewpoint of the entire national economy, which is necessary in this important matter, and one requiring enormous expenditures. Therefore, the money which is earmarked for integrated automation should be spent primarily on the development of various kinds of equipment for the industrial engineering system, in particular, automatic equipment for storage and transport between operations. Unfortunately, these devices and machinery have nowhere been made on a centralized basis. Our plants are also not producing the microprocessor equipment for monitoring equipment operation. Each machine tool must be supplied with this equipment in a modern production process, since it enables feedback in the control system.

Alas, for the present we have a paradoxical situation: Integrated automation in the machine building industry is not developing in an integrated fashion. First, attention was paid to the development of industrial robots. Now machine building is aimed at the introduction of robotized production-process modules. Meanwhile, the production of equipment for the industrial engineering system has for some reason not been planned up to now. So, it has turned out that essentially there is nothing to fill a highly organized production environment with, and without it the efficient operation of production-process modules can be placed in doubt.

It seems to us that to make it easier for enterprises to implement the two-stage approach planning agencies should regard the first stage in the development of a GAP as an independent planning unit with its own introduction deadline and individual incentives. It is in general a good idea to legitimize the very concept of the industrial engineering system of a GAP as being of independent importance. The introduction of this system makes it possible to relieve human beings from industrial engineering operations, just as a production system totally replaces manual labor in processing a product.

Both processes are identically important. Inadequate equipment utilization in diversified-range production is an objective phenomenon, widespread over the entire world, and regardless of the kind of product produced. Now the technical ability to eliminate this situation has appeared. It is intolerable that the vast inventory of machine tools now in operation in this kind of production should be left outside of these new organization opportunities.

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## AUTOMATED LINES AND AGGREGATED MACHINE SYSTEMS

### IMPLEMENTATION OF LARGE MACHINING CENTER FOR HEAVY INDUSTRY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 19 Jun 85 p 1

[Article by A. Lyakhov, Novosibirsk correspondent for SOTSIALISTICHESKAYA INDUSTRIYA, under the rubric "Reportage": "A Giant in Assembly"]

[Text] These days at the Tyazhstankogidropress Plant, assembly of the first experimental model of a machining center for heavy industry has begun. The communists of the enterprise--the entire collective--perceive mastery of the new machine as the party's combat task in solving the complex and many-sided problem of the technical re-tooling of the leading industrial sector.

The chief designer of electric drives, A. Tuv, and the chief designer of machines, B. Prikhno, are unrolling a tremendous sheet of Whatman drawing paper: the "portrait" of the future machining center.

"Today we are producing machines which will allow us to raise productivity by 1.5 times or 1.6 times at the maximum," explains B. Prikhno. "But already in the 12th Five-Year Plan which stands just before us, for the solution of the immeasurably growing tasks in all sectors and most of all in heavy machine-building, machines which give no less than a three-fold increase in productivity are necessary. From the horizontal milling-boring, longitudinally machining and special machine-tools, which we have designed and learned to make, we must proceed to the next stage."

Prikhno passes the palm of his hand over the drawing.

"This machining center will allow us to increase labor productivity by 3 to 3.5 times. In essence, without the participation of man, it is capable of machining a 50-ton piece of large dimensions with high precision in a minimal time. The foundation of the center is a four-coordinate, horizontal milling-boring machine-tool, the 2G660P4. This completely new machine allows performance of the most complex technological operation during a single set-up of the piece, shifting the tool in any direction. When it is required, the machine-tool itself will automatically change the tool and the equipment."



... We are going to the fifth shop through a large yard, through bays wide as city avenues, by machine-tools which look like steam engines. At Tyazhstankogidropress all is huge: the workshops, the equipment, and the output. Along the way the plant director, B. Aranovskiy, explains:

"We are conducting preparations for mastering the centers, as they say, from two ends: in the design bureau and in production. If we dawdle, we will not keep within the time periods. But in 1987 we must master them."

We stop beside an imposing steel structure.

"This is the bed-plate of the 2G660F4 machine-tool," says V. Kosyrev, the bay-chief, who has worked at this plant for more than 40 years and has been awarded several government decorations. He has been entrusted with assembling the new machine.

"That means that the machining center is already working?"

"Exactly!," the director affirms. "This machine-tool model will remain at the plant: let the designers, technicians, and operators break it in and bring it up to snuff! But the next one already is for the complex."

"Is it a complicated machine?," I ask the brigade-leader of the assemblers, N. Belyayeva.

"We are coping," he replies. "The kids are skillful, with experience."

The assemblers are also getting ready to take up express delivery. The secretary of the party buro of the shop, the engineer I. Shteyzel, and others attentively study the new technology.

How huge it is, this heart of the future complex! I throw back my head to make out its contours under the bays. It is over six meters high....

"And this system should work like a heart," says A. Tuv, a USSR state prize laureate, a great expert and talented electric drive designer, as if guessing my thoughts. "First of all, it must work almost round the clock and with great reliability. Second, in case of a malfunction, with the help of the electronic systems it should answer itself as to where it 'hurts', and what 'hurts', so that a person can repair the defect in a moment. And third, it will monitor itself and immediately produce a complicated certificate--a distinctive sort of 'cardiogram'--on the quality of the operation performed. The task has not been simple; many questions had to be answered for the first time. I think that we are coping with the task and that industry will receive a dependable, highly productive machine."

Every step around the plant, every new meeting gives birth to a feeling of intensity and responsibility, which are set in motion by the thoughts and deeds of the people.

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## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

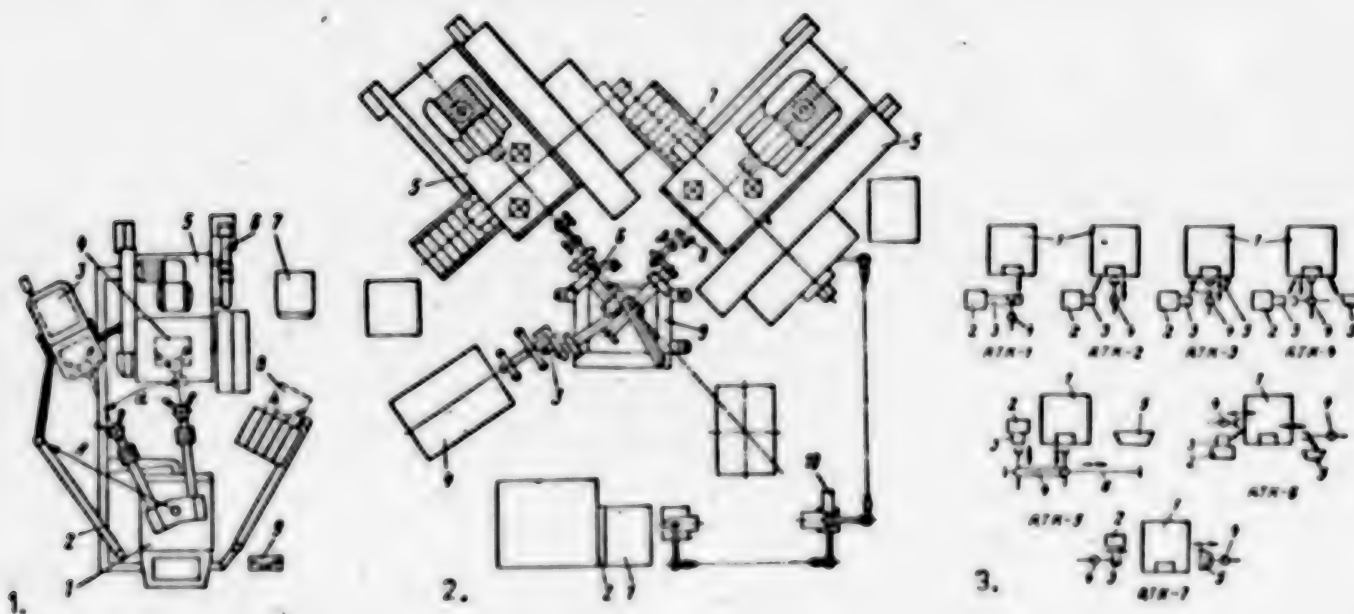
### ROBOTIZED METALWORKING MACHINES DEVELOPED IN ESTONIA

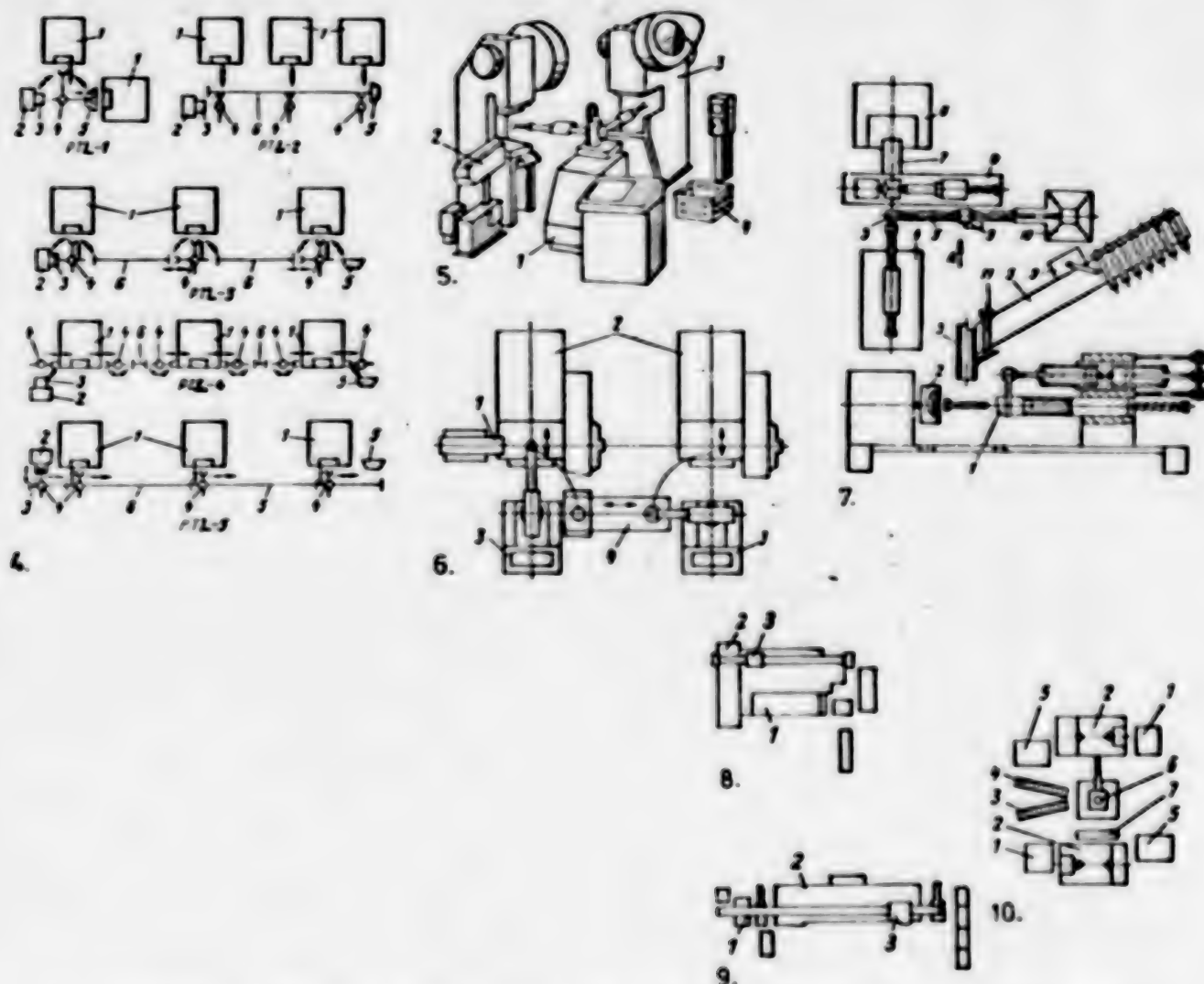
Tallinn TEHNIKA JA TOOTMINE in Estonian No 7, Jul 85 pp 16-19

[Article by A. Koppel: "Industrial Robots in Metalworking"]

[Text] Metalworking can be automated with conventional methods, but a much greater effect is obtained when they are combined with industrial robots. An analysis of sheet metal pressing's technological part indicates that currently the following operations can be successfully performed by robot-technological complexes: preparation of the sheet metal for cutting or slicing, delivery of the raw material to the press and the removal of the product, removal of scrap from the press area, transportation of parts and products between operations, to include delivery from one press or machine tool to the next, product storage, scrap collection, etc.

Several organizational-technical schemes have been developed for the above mentioned operations:





-- A robotized module "robot-press" or "robot-press-robot." Diagram 1 is the rebotechnological plan of the AKK-100PR complex for sheet metal pressing of parts with a mass of up to 2.5 kg. In the diagram 1 is the industrial robot (automatically guided manipulator) KM10Tz4201, 2--rail, 3--magazine, 4--die, 5--KD 134 press, 6--KD 2330 press, 7--electrical junction box, 8--storage, 9--moveable control panel;

-- A robotized department "press-robot-press." Figure 2 depicts the plan of the 2KD2330.01 robot-technological complex for pressing cover or ring-type parts with a weight of up to 1.6 kg from sheet metal. On the figure 1 is the electrical junction box, 2--distribution box for the electrical wiring, 3--sensors, 4--magazine, 5--KD 2330 press, 6--distribution box for the pneumatic system, 7--coasters, 8--vacuum and pincer grippers, 9--three armed KM5Ts4201 robot, 10--rails;

-- A robotized line that consists of the described modules and departments, including reception, transferring, orientation and other devices.

The seven typical robot-technological systems for pressing parts out of sheet metal are depicted on Figure 3, with 1 being the press, 2--part collection device, 3--position for removing parts from storage, 4--industrial robot, 5--storage, 6--device for robot transportation. In the first robot-technological kompleks (RTK-1) the robot merely loads the press, using two planes of movement, up and down and back and forth. The second complex (RTK-2) differs from the first in that manipulator rotation is used in placing the parts into the press. The third complex (RTK-3) is designed not only to place the raw parts into the

mold, but also for removing finished parts from the mold and placing these in storage. In the fourth complex (RTK-4) one arm of the robot places the raw part in the mold, the other arm removes the finished part. In the fifth complex (RTK-5) the on and offloading functions are the same, but these are accomplished not by rotating but by parallel shifts of the arms. In the sixth complex (RTK-6) the first one armed robot places the raw part, another one removes the molded parts. The seventh complex (RTK-7) consists also of two one armed robots, but instead of arm rotation it uses linear movements up and down and back and forth.

Diagram 4 depicts the five type structures of robotized technological lines, with 1 being the press, 2--magazine for storing parts, 3--position for removing parts from the magazine, 4--industrial robot, 5--collector, 6--transportation device. A line may have two or more robotized technological complexes. In the first line (RTL-1) raw parts are placed on the press, offloaded and transferred from mold to mold by two armed robots, while the second line (RTL-2) employs one armed robots located next to every press, with transfer from press to press taking place with the help of the transportation device 6. The third line consists of a series of RTK-4 robotized complexes that are connected to each other by a transportation device, in the fourth line (RTL-4) there are identically placed RTK-6 robotized complexes. In the fifth line (RTL-5) every robot takes the part from the previous position and transports and places it to the next position.

Diagram 5 is a schematic drawing of the L614 line, with 1 being the RPD-1,25 industrial robot, 2--PSch-1 loader, 3--KD2122 press, 4--storage for finished parts.

Diagram 6 depicts the scheme of an automated sheet metal molding line that consists of two robotized modules connected to each other by a step transporter, with 1 being the feeder, 2--presses, 3--industrial robots, 4--step transporter.

The reliability of the line depends greatly on the instrumental and molding equipment. In projecting that the requirements and peculiarities on industrial robot use must be considered. The construction of the equipment included in the line must guarantee both sequential and independent functioning of the presses, with each of them also being capable of functioning as a freestanding technological unit. Planning of the line includes consideration for easy entry to the working zone, with changes in the molding equipment possible in a mechanized fashion.

Before operating an automated line the parts to be finished must be analyzed and grouped according to constructive and technological characteristics, and the optimal runs must be determined so that the fewest possible retoolings are required and that these would be as simple as possible. Robotized complexes must be able to function independently.

Industrial robots are used in the cold plastic deformation of parts as well. For example, in the Tashkent Tractor Factory imeni USSR 50th anniversary as robotized complex for pressing bolts from rod materials has been implemented (bolt mass 0.16 kg, head diameter 28 mm). The two armed industrial robot Tsiklon 3B of the complex takes with one hand the segmented part, prepared in the first press (not served by the robot) and places it in the mold of the second press, with the second arm it removes the semi-finished part from the second press and places it in the mold of a third press, removing it after the part is finished. A cycle for finishing the part last 12 seconds, the complex is served by one worker, an estimated two jobs were saved.



For subsequent finishing of molded bolts the Kovrov Mechanical Factory also uses a robotized complex consisting of three modules. Each robot includes a cutting die and a servicing Tsiklon 3B industrial robot. The modules function autonomously, the robot removes the unfinished bolt from the magazine, places it on the cutting die, removes it after finishing, and places it in storage. Every module finishes bolts with specific dimensions, with the procedure taking 20-25 seconds. As a result of automation one savings of one worker per shift were made.

A robotized technological complex for finishing large nuts on the KhA9395 aggregates has been installed in the Ural Railway Car Factory imeni F. Dzerzhinskiy. A Tsiklon 3B industrial robot removes the unfinished part from the magazine and places it in the semiautomatic contrivance. A part that has arrived at the same position is rolled through a trough into storage. The cycle of finishing a nut lasts 50 seconds. The complex is serviced by one worker.

In robotization changes in the basic and auxiliary time proportions are important. This is important in sheet metal molding, but especially in mechanical finishing where a raw part is in a machine often only five percent of the time and even there only 30 percent of the time is spent in cutting. Good results in tightening processing time by using robots have been achieved in the mechanized finishing of various rotating parts. Here robot selection is often dependent on their operating speed that must correspond to the time required to process a part. Use of robotized complexes instead of manually operated simple machines has been effective. For example, in the Volgograd Tractor Factory eight workers on four machines, working in two shifts, were able to cut the required number of axles and thread the needed number of bolts. By rearranging the technological process and installing a complex using the PR-10 robot these processes were fully automated (Diagram 7). In that robotized complex the raw parts 11 are sent from magazine 10 to an inclined table 5 where they are kept in place by the fixator 9. In every operating cycle the fixator frees one raw part that moves to chute 3, assumes a rigidly vertical position and falls into the gripper of robot 4. The latter moves the raw part into the work zone of the threading machine 8 and rotates the part by 90°. Upon a signal from the robot the compressed air nozzle is opened that the part is approached by a hollow tube with the cutting instrument. Robot 4 loosens its gripper and places the raw part in the hollow tube, moving itself back into the starting position and freeing the machines work area. Now the robot gives a second signal whereupon the compressed air enters the other part of the cylinder and activates the piston. The piston rod nudges the hollow tube with the raw part, placing its head in the chuck of a rotating cartridge 2. At the same time the cutting instrument approaches the part and perform the cutting operation. Then the cylinder of the pneumatic system moves back to the starting position, the part is freed and falls through an opening in the machine bed into the inclined trough 7 along which it rolls for threading to a second machine 6. At the same time the robot grips another raw part from the chute and takes it to the work zone of the cutting machine. Thus the robotized complex allows for simultaneous preparation of the part, cutting, and threading.

Using robots to service programmed machines allows for automation of auxiliary movements, primarily the delivery of the raw part to the machine and the removal of finished products. In spite of the quite considerable capital investments made in installing robots their economic effect is considerable.

For example, servicing of four automatically programmed machine tools with two robots frees three workers, with savings amounting to more than 4400 rubles annually.

A prerequisite for using robots with automatically programmed machines for large scale production is specialization and grouping of identical part production. This permits the increase of machine utilization from 0.6-0.65 to 0.85. Robots can also be successfully used in thread cutting, thread rolling, and other semiautomatic machines even when these machines are included in automated lines.

In the Leningrad Producing Combine "Elektrosila" imeni S. M. Kirov a department consisting of two automatically programmed machine tools and a PR-4 industrial robot has been established. The robot removes the raw part from the magazine and places it between the centers of the first lathe. The part is fixed by the rear center chuck, the robot arm is removed from the work zone and the lathe is turned on. At the same time the robot grips the part that has been finished on one end and places it between the centers of a second, identical lathe. The latter is turned on only after the robot arm has moved to the first lathe and the safety shield of the second machine is in place. The part is removed from the second lathe also by the robot.

The PR-4 robot's gripping mechanism is pneumatically operated. Its lifting capacity (5 kg) is sufficient to process parts with a diameter of 22-38 mm and a length of 100-420 mm. The cyclical system of robot guidance allows it to function in a complex with the department's primary and auxiliary machines. Robot preparation and "training" takes almost two hours, during which a program is devised, the operation sequences are verified and entered. Then the other machines are attuned and the automatic operation of the system is checked.

Diagram 8 depicts a robotized complex for finishing axles with a diameter of 220 mm and a length of 710 mm. The complex has been installed in the Moscow machine tool factory Krasnyi Proletariy. The complex includes the program guided 16K20F3 machine tool 1, an auxiliary device (magazine) 2, and a SM80Ts4811 robot 3. Diagram 9 depicts the complex for finishing bolt heads with a diameter of 630 mm (installed in the Ryazan Machine Tool Combine) with 1 being the auxiliary device (raw material magazine), 2--1P756DF3 program guided machine tool, and 3--SM80Ts2501 robot.

Diagram 10 depicts a complex consisting of a program guided machine tool and a PR4 industrial robot for finishing a series of axles. The series includes more than 2000 axles. The complex has been installed in the Leningrad "Elektrosila" production combine. On the diagram 1 is the hydraulic device, 2 the cutting tool, 3 the collector of finished products, 4 the magazine for raw parts, 5 the control panel for the programmed machine tool, 6 the robot and 7 the reloader of unfinished parts. The robot's task includes the placing of unfinished parts in the two tools and their removal. Finishing of one part takes two to three minutes, with time in the machine amounting to 1.5 to 2 minutes. The department has been planned so that the robot is centrally placed. The machines include devices for opening and closing of safety shield, and sensors that signal if a unfinished part is missing.

The use of robots in finishing axles increased productivity by a factor of 1.5, with the machine use factor increasing from 1.5 to 2. The annual savings amounted to 7000 rubles; the robot paid for itself in three years.

In implementing robotized complexes safety requirements laid down in the OST3-12.002-80, OST3-12.003-80, and OST 12.3.026-81 standards must be met.

Several variations are conceivable in servicing machine tool groups with robots-- this can be done progressively, i.e. in sequence, cyclically, etc. The criterion for comparing them is the operability factor of the machines to be serviced. In a typical closed massive servicing the operability factor of the machines is greater in the first variation than in the second. Considering the relatively low intensity and the small number of machines used in sequential processing the variations mentioned are almost identical. In that case cyclical operations are preferred, since in that case realization of robot guidance programs is easier.

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## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

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### FLEXIBLE AUTOMATIC PRODUCTION AND LABOR PRODUCTIVITY

Moscow MASHINOSTROITEL in Russian No 11, Nov 84 pp 37-39

ZHUKOV, L. I., doctor of economic sciences, professor, ZAVARINA, G. V. and KONNOV, V. A., candidates of economic sciences

[Abstract] Significant production increases related to flexible automatic production methods (FAP) as the foundation for improvements in labor productivity are discussed as they affect Soviet industries. Social limitations and the potential for robot utilization and other automation applications are assessed in relation to economic efficiency. A major element is production of "short runs" of milling and other equipment efficiently so that innovations can be made without hesitation that might be encountered where extensive retooling costs for machine production block technological advances. The 20-30 year useful life projections of previous years have become unacceptable, given the tempo of modern technological advances. At the same time, worker satisfaction forms an important part of the overall impact of production results, and must be taken into consideration. The authors present formulas that take account of costs for innovative techniques, impact on raw material and process costs, final costs and human (labor) impact, to show the comprehensive economic effect of FAP methods per unit of production. The proposed method of assessment would contribute to planning production increases and balancing capital and labor input against output, as well as to more efficient use of the labor force. 1 figure.

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8 January 1986

